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Sugarcane Cultivation in Mysore.

PART III.*

BY

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Introductory :—Sugarcane is one of the "money-crops" of the State and its cultivation is undertaken over the whole of the State, wherever facilities exist. It is said that the *Pattapatti*—a variety of this crop—was introduced into Mysore during the time of Hyder Ali. Mr. Rice says in this connection :—"*Rastali* is the original sugarcane of the country. Pattapatti was introduced, it is said, from Arcot in the time of Haidar, by Mustafa Ali Khan, a Pay-Master General." At the present time the Pattapatti is the most popular variety, the Rastali—the original cane of the locality—taking a secondary place. Both these are thick soft canes—the Rastali being almost identical with the Pundia of Bombay Presidency—and are usually grown where water supply is assured. Wherever water is scarce, a variety of cane called Cheni, a thin hard reed-like cane, is grown and this

* For Parts I and II on the subject *vide* Vol. V, No. 3, 1923.

also seems to have been grown from a very long time. Sugarcane is a crop which ordinarily takes about twelve months to come to maturity ; the Cheni takes a longer time. It readily responds to good cultivation and proper manuring, and requires an assured supply of water throughout the year. During recent times, a number of foreign varieties of cane have been introduced with a view to increase the yields. Attempts are also being made to grow seedling canes and a good deal of success has attended the efforts of the Agricultural Department in this direction.

Preparatory tillage :—Thorough tillage of the soil at least to a depth of eight inches is essential for the proper growth of sugarcane. The cultivator who does not use the improved implements recently imported into this country and now available in most places, ploughs his land a number of times and at frequent intervals. At least ten ploughings are given with the country plough at intervals, thus thoroughly stirring and aerating about six inches of soil. Great importance is attached to the complete aeration of the soil. Using the heavier kind of steel ploughs one ploughing ordinarily, and two when green manure is turned in, are enough. After ploughing, the clods must be crushed and the land cultivated repeatedly till the soil is brought to a fine tilth and is well aerated. The trouble taken in properly preparing the soil is always repaid by good crops. For cultivating the land after ploughing and after the spreading of manure, the disc-harrow is an admirable implement. It breaks up the clods brought up by the plough and mixes the manure very thoroughly with the soil. Care must be taken to put the disc on to the land almost immediately after ploughing when it is easiest to pulverize the clods, which, if allowed to dry up, become very hard and give a good deal of trouble later on. In the absence of the disc-harrow, the sixt-tyned cultivator can be used and quite good results can be obtained with it. When a previous crop of green manure is grown and ploughed in, it should be ploughed in about six weeks before the planting of sugarcane so that the green stuff that is turned in may have time to rot sufficiently to allow the necessary operations on the field being completed just before planting.

Preparation of setts for planting :—The part of the cane that is most preferred for planting is the top. When sugarcane is harvested, the tops are removed and utilized for planting. This is because

germination of the buds in the tops is more certain and quicker than that of the buds lower down. Where the number of tops available for planting is not enough, the lower parts of the cane are also used. The buds in this portion of the cane do not germinate so readily as those in the upper portion which contains less sucrose and is thus not so desirable for crushing purposes. The use of only the top portion, therefore, for planting purposes and the bottom portion for milling is advantageous in two ways, a good quality of jaggory is obtained and a good germination of planted cane is also got. It is often difficult to get only tops of canes for planting, those that are obtainable being insufficient to cover the area to be planted, and in such cases the whole cane is used for planting, and though germination is a bit slow, still quite good results are obtained. The cane is cut into small bits for planting and each bit usually contains three eyes or buds or nodes. The distance between the nodes in the tops being very small, the tops usually contain more than three eyes. A careful farmer selects the setts that he plants and sees that none of them is diseased in any way. The setts should not be allowed to dry out after being cut and must be planted as soon as possible after cutting. If proper care is exercised in selecting and planting setts, a very good germination can be easily obtained.

Methods of planting:—When ploughing and harrowing is completed, a certain amount of levelling will have to be done considering that sugarcane is an irrigated crop. This is usually done by means of the "*Halube*", after the clods have been crushed either by means of the disc or by hand, using wooden mallets according to the local practice. After levelling is done, the plot is divided into a number of beds about 10 feet square and separated from one another by small furrows, or long furrows are made from one end of the field to the other with suitable interspaces between the furrows. In the first method, after the beds have been marked out, small shallow pits about a foot and a half in diameter and about six inches deep are dug at intervals of about three feet, and in each pit from two to five setts are planted after they have been individually manured. These pits are then watered by hand, the water being taken from depressions in the furrows at suitable intervals. This is called the pit system of planting. In the other method, the cane setts are planted in furrows which run continuously from one end of the field to the other. Water

is first let into the furrows to soften the soil and into this the setts are sometimes pressed by hand and sometimes trampled. The practice varies from place to place, the setts sometimes being placed continuously one after another and in other cases, some distance being allowed between two consecutive setts. This system is called the furrow system of planting, and is advocated in preference to the former because (1) the amount of labour involved in the preparation of pits is much more than that involved in the making of furrows and (2) planting in furrows is less laborious and easier than planting in pits.

Distance of planting :—Where the furrow system is practised, the local method is to have the furrows as close apart as to leave only a foot or a foot and a half between the furrows. This tends to overcrowding of the crop resulting in small and stunted canes. Experiments are being carried on at the Hebbal Farm to determine the best distance between the furrows. The experiments were started with giving 1′, 2′ and 3′ interspaces between the furrows, and the following figures obtained :—

	No. of canes	Wt. of canes per acre
1 foot	39,204	25.28 tons
2 feet	36,119	26.98 ,,
3 feet	32,955	33.70 ,,

Having found that three feet spacing was very much better than either 1 foot or 2 feet, the experiment was modified dropping the 1 foot and adding on 4 feet interspacing in its place. The results so far obtained are as follows :—

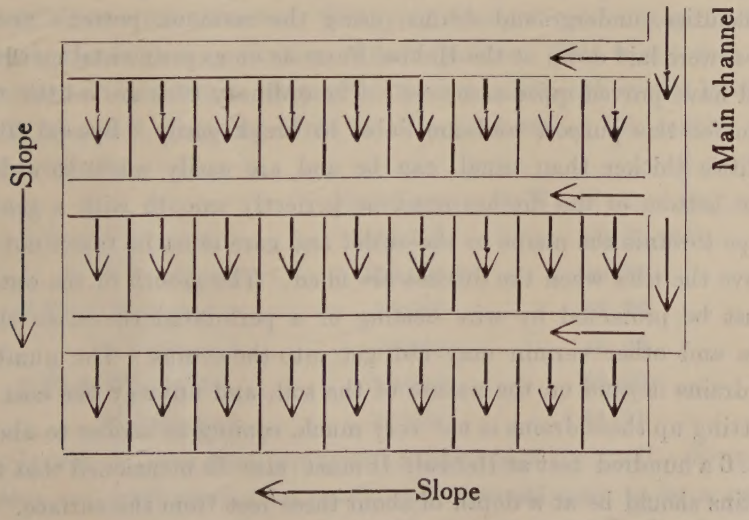
1918—19	No. of canes	Wt. of canes per acre
2 feet	32,885	40.52 tons
3 feet	30,439	42.53 ,,
4 feet	29,243	44.64 ,,
1919—20		
2 feet	27,659	34.48 ,,
3 feet	26,076	35.87 ,,
4 feet	25,318	36.58 ,,

Although the wider spacing of 4 ft. between the rows has given better yields in certain years, it has not yet been conclusively proved that it is the best spacing under Hebbal conditions. It is easy to see that while wider spacing gives better yields, it at the same time

reduces the cost of production considerably by utilizing less amount of seed, and lessening the expenses incurred in connection with weeding, manuring, digging and earthing up, and wrapping. No extensive tests have yet been made about varying the distance between consecutive setts in the same furrow.

Irrigation :—Sugarcane being a crop that requires plenty of water throughout the year and especially so during the earlier stages, an assured supply of water is essential for obtaining good yields. Sugarcane is, therefore, grown only under tanks and channels witha perennial supply of water. The Cheni variety of cane, however, can be grown even in places where the water supply is not quite sure, as it can tide over spells of drought to a certain extent. The channels of the Cauvery that are newly being brought into existence may, therefore, be expected to extend the cultivation of cane in their neighbourhood.

Where cane is planted in pits, the pits are hand-watered till the canes grow up to one or two feet. After this, furrows are made in the beds and each bed is then watered separately from the channels running between the beds. In the furrow system of planting, the field is divided into a convenient number of strips across the direction of the furrows, the number depending upon the slope of the field and each of these strips is watered separately.



The diagram shows a field which is divided into three such strips necessitating cross channels from which water is slowly drawn into

the furrows. A man follows the water, opening and closing the ingress to the furrows as they get filled with water. When one strip is completed, water is diverted into the next cross channel and the next strip irrigated similarly. If the slope is not great, the furrows may run from one end of the field to the other, these being irrigated from a head ditch at the top of the field.

Irrigation is given to canes usually once in about ten days, but this period is variable with weather conditions. During the rainy season, irrigation is given less frequently and in the hot and dry season, more frequently.

While sugarcane requires plenty of water for its growth, it does not like water-logging. The crop is very sensitive to stagnation of water in the field and does not thrive under these conditions. Ordinarily sugarcane requires proper aeration of the soil and subsoil for satisfactory growth. Where, therefore, conditions are such that water is likely to stagnate in the field, some sort of arrangement for drawing off the water is necessary. This usually takes the shape of open ditches, the size and number depending upon the nature of the soil and the amount of water to be drained away. Such ditches are a great hindrance to the proper working of the field as they cut up the area into fairly small bits. Again the ditches have to be cleaned very often to keep them free of vegetation. To get over these difficulties, underground drains, using the common potter's uncut tiles, were laid down at the Hebbal Farm as an experimental measure and have proved quite a success. The ordinary tiles are a little too thin for this purpose and are liable to break easily. Special tiles, a little thicker than usual, can be and are easily made to order. The bottom of the ditches must be perfectly smooth with a gentle slope towards the mains or the outlet and care must be taken not to move the tiles when the ditches are filled. The mouth of the outlet must be protected by wire netting or a perforated cover, so that rats and other vermin may not get into the drains. The number of drains depend on the nature of the soil, and anyway the cost of putting up these drains is not very much, coming as it does to about Rs. 6 a hundred feet at Hebbal. It must also be mentioned that the drains should be at a depth of about three feet from the surface. If they are deeper, the drainage will not be efficient; if they are shallower, the drainage may be too great demanding more frequent irrigations

and further the roots of the sugarcane will penetrate into the drains and tend to block them up.

After-cultivation to sugarcane consists mainly in weeding, digging and earthing up. If the area is small, these are usually done by hand. No definite figures can be given about the number of times weeding has to be done, as it depends entirely on the nature of the land and its freedom from weeds. Three diggings are usually given commencing from about the fifth month and at an interval of about six weeks between two consecutive diggings. The weeds are thoroughly removed at this time, a top dressing of powdered cake of some sort given, and the loose soil earthed up on the rows leaving a channel for water in between the rows. As far as possible the top soil must be kept as free from weeds and as loose as possible. Where the area cultivated is large, bullock implements can be used for all these operations, using suitable implements. The use of fertilizers has been discussed in another article in a previous number of this Journal.

A peculiar practice not found with other crops is the wrapping of canes. This is the tying up of clumps of cane with dry and half dry leaves of the canes in the clump, and this operation is done about three times. The object of this is said to be to prevent the lodging of canes, to protect them from jackals, and to keep the field clean. The cost of this operation comes to about Rs. 40 an acre, and varies according to circumstances. Wrapping does prevent lodging to some extent, but is poor protection against jackals. This is not done in the case of Cheni cane. Experiments were conducted on the Hebbal Farm to see if wrapping could be dispensed with. The results are given below :—

	No. of canes	Wt. of canes per acre
2 Feet Wrapped ..	22,792	46.22 tons
Unwrapped ..	20,095	40.60 ,,
3 Feet Wrapped ..	20,740	52.26 ,,
Unwrapped ..	18,849	46.87 ,,
4 Feet Wrapped ..	19,043	49.60 ,,
Unwrapped ..	17,261	44.21 ,,

It will be seen that wrapping usually pays for itself. Even if it does not yield much of a profit, still it would seem to be a good thing to wrap canes wherever possible at least for the sake of keeping the field clean. There will then be no hiding place for rats and

men could easily move about in the fields for irrigation and intercultural purposes. The elaborate wrapping that is usually done may be dispensed with where large areas are worked, but it is advisable in such cases to restrict this operation to merely prevent dry leaves from falling down and obstructing the passage of men through the field.

The field on which sugarcane is grown being well provided with underground drainage, paddy is not a crop which is suited for rotating with cane. The conditions required for these two crops are so divergent that the poor crops of cane generally obtained by the cultivator are probably due to this unsuitable rotation being practised in many places. Crops which require only a moderate amount of irrigation, and which thrive well under the same conditions as does sugarcane—like maize, jola, cowpeas, vegetables, etc.—must be selected for rotating with sugarcane. A rotation that was found quite successful on the Hebbal Farm was :—Sugarcane one year followed by French beans, maize and cowpeas in the order given. All these three crops are obtained in one year, the last crop of cowpeas being ploughed in as a green manure for the next crop of sugarcane.

Harvesting and milling :—Cane is usually harvested when it is twelve months old. The wooden mill has almost practically disappeared giving place to the three-roller iron mill. Various patterns of the latter are in use and the Department recommends the use of a mill made by the Nahan Foundry in the Punjab. The extraction ordinarily obtained is about 65% of juice on the weight of cane. The juice thus obtained is almost invariably boiled down in open pans into jaggory and marketed immediately. The question of the furnaces now in use and improvements which can be made in them will be treated in another article. Where cane is grown round about big towns, it is sold as such for chewing and yields a better return than when made into jaggory and sold, but this is only possible, as already said, near big towns and cities.

It will be seen that sugarcane is a crop which requires liberal treatment. Cultivation expenses are high and expenditure should not be stinted as this is a crop which responds very readily to good cultivation and heavy manuring, giving handsome returns. As irrigation facilities in the State increase, there should be an increase in the cultivation of sugarcane and we can confidently look forward

to a time when Mysore can not only meet its own demand for sugar, but can also export large quantities. It is well known that some of the best canes in the world are grown in Mysore and with improved methods, both of cultivation and manufacture, we must be able to produce record yields.

Mysore-American IV—A new form of Doddhatti for our Red Soils.

BY

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To trace the history of the introduction and development of American cottons in India will be to tread over the same field which has been traversed by many. The latest on the subject comes from Mr. J. Mackenna who, when he was the President of the Indian Cotton Committee, delivered a lecture on the early history of cotton in Bombay, to the students of the Cotton Association of the Sydenham College of Commerce, Bombay.* The same story is repeated over and over again of how the constantly increasing demand for cotton excited the interest of the East India Company ; how in 1788 the Court of Directors called the earnest attention of the Governor-General to the necessity of improving the cultivation of cotton in India ; of how the fortunes of Indian cotton varied with the exports of American cotton ; of how the Indian cotton could not be used by the British manufacturers and in consequence the Court of Directors turned their attention towards the improvement of the staple ; of how after a series of reverses the American cotton was practically established in Dharwar and is familiar to all who have perused the literature on the subject.

From the records† available it is seen that trials with American cotton in Mysore were first made by Mr. Meppen near Kadur between the years 1845—50. Partly through his efforts and those of Dr. Cleghorn and partly as a result of the influence of the adjoining taluks

* *The Agricultural Journal of India*, Vol. XIII, p. 389.

† Royles :—*The Agriculture and Commerce of Cotton in India*, p. 532.

of the Bombay Presidency, the American cotton, a mixture of New Orleans and Upland Georgian, is being grown in our State, especially in certain taluks of Shimoga and Chitaldrug districts and its cultivation is being extended into other districts, favourable for the growth of this variety.

Dr. Barber has discussed the suitability of tracts in the Madras Presidency for the introduction of superior cottons of the Hirsutum type with reference to the rainfall and has made the following deductions : That, according to Fletcher, the Karnatic is the most suitable tract where Hirsutum variety has established itself as an annual crop without irrigation, because there, the rainfall distribution is better. The distribution of rain in the Karnatic is as follows :

Total rainfall—21.1".

May	1.4"	September	3.9"
June	3.6"	October	2.6"
July	3.6"	November to April ..	3.5"
August	2.5"		

Applying this method, he has divided the Madras Presidency into three tracts :—

1. Suitable for the introduction of American cotton. Hadaguhalli, Harapanahalli, Cuddappah, Cuddalore, Panruti and Pollachi.
2. Probably suitable : Adoni, Nandayal, Anakapalli and Madura.
3. Possibly suitable : Coimbatore and Erode.

If we apply the above method to the Mysore State and ascertain how far it is suitable for developing cultivation of Doddhatti, we find the following :—

Locality	Monthly distribution of rainfall		Total
Karnatic	0000.xx.x.00		25.8
Chamarajnagar	000.x...xxx0	Suitable	25.16
Channagiri	000.xxxxxx.0	Most suitable	27.40
Honnali	000.xxx.xx.0	Do.	23.05
Hassan	000.xxxxxxx.	Do.	35.61
Arkalgud	000.xxxx.xx.	Do.	33.00
Belur	000.xxxxxx..	Do.	36.88
Channarayapatna	000.x...xx.0	Possibly suitable	24.80
Arsikere	000.x.xxxx.0	Most suitable	25.42
Hole-Narsipur	000.x.x.xx.0	Suitable	27.30

Locality	Monthly distribution of rainfall		Total
Alur	000.xxxxxx.0	Most suitable	38.87
Banawar	000.x.x.xx.0	Suitable	23.57
Kadur	000.x....x.0	Not suitable	22.18
Tarikere	000.xxxxxx.0	Most suitable	31.86
Chitaldrug	000.x.xxxx.0	Do.	24.40
Holalkere	000..xxxxx.0	Do.	23.92
Davangere	000..xxxxx.0	Do.	22.18
Hosadurga	000.x.x.xx.0	Suitable	23.09
Harihar	000...x.xx.0	Possibly suitable	20.26
Malebennur	000...x..x.0	Do.	19.26

Symbols :—

Each symbol represents a month in the year.

0 Less than $\frac{3}{4}''$ of rain in the month.
. Between $\frac{3}{4}''$ and $2\frac{3}{4}''$ do.
x Above $2\frac{3}{4}''$ do.

From this it will be seen that there are in Mysore, areas where the American cottons are being successfully grown and where their cultivation may with advantage be extended.

Although this cotton is grown with advantage and its cultivation is being gradually extended still it has a serious drawback in that it usually develops a kind of leaf-disease in which the leaves redden and drop off and in certain years this may be quite serious. Though the disease is not of such a nature as to kill the plants still it so greatly weakens them that the yields are not as high as they ought to be. The disease is supposed to be due to a physiological cause and apparently there is no remedy as yet known.

The problem that now confronts us is either to find a remedy for the disease or to evolve a variety that will resist it and at the same time give a higher yield and a superior staple.

It may be mentioned here that attempts made to introduce improved varieties recently developed in America, have not proved a success in India. For, Mr. Keatinge in his written evidence presented before the Indian Cotton Committee,* remarks, "We have had no luck with the recent American cottons we have imported." Again Mr. Burt in his evidence † says, "None of these have done well even after several years

* Minutes of evidence to the Indian Cotton Committee, Vol. II, p. 98.
† Do. do. Vol. I, p. 17.

of acclimatization nor has it been possible to isolate high yielding types from them. If a better cotton is required it must be obtained by hybridization."

In order to see whether an improved type of cotton could not be evolved by crossing, hybridization work on this cotton was started in 1919 and we have been able during this season (1923—24) to fix a type which is superior in many respects to the local Doddhatti.

In doing a piece of work in hybridization on any crop the most important point to ensure success is the choosing of the parent plants. The expressions, "We must plan the work with great care, have definite ideas and work to a line" are all too familiar in any book on Plant Breeding. Therefore, in trying to plan the work for developing an improved type of Doddhatti by hybridization, we had the following points in mind:—

Firstly, the new variety must be free from disease. Secondly, the plants must be hairy with short inter-nodes and must have as few vegetative branches as possible. Thirdly, the shape of the fruit must be conical instead of being round, as it appears from results obtained by Cook that there is a relation between the shape of the fruit and the length of the lint. Lastly, the quality of the lint must be superior.

It is hardly necessary to state that of the two parents used for hybridization one must be the Local Doddhatti. The question arises as regards the selection of the other parent. Sir George Watt in his book, * "The Wild and Cultivated Cottons of the World," traces the origin of the several varieties of the Egyptian cottons to *Gossypium Peruvianum* which is a tree cotton and it has been observed that the tree cottons do not generally get the red leaf-blight. It struck the writer that if a cross be made between the above-named tree cotton and Doddhatti it might be possible to evolve a variety which might resemble the Egyptian. With this end in view a cross was made in 1919 between an American upland and a tree cotton which practically answered to *Gossypium Peruvianum.* The F 1 plants were intermediate in habit. (See Plate No. I fig. A.) The

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* Watt: *The Wild and Cultivated Cottons of the World*, p. 214.

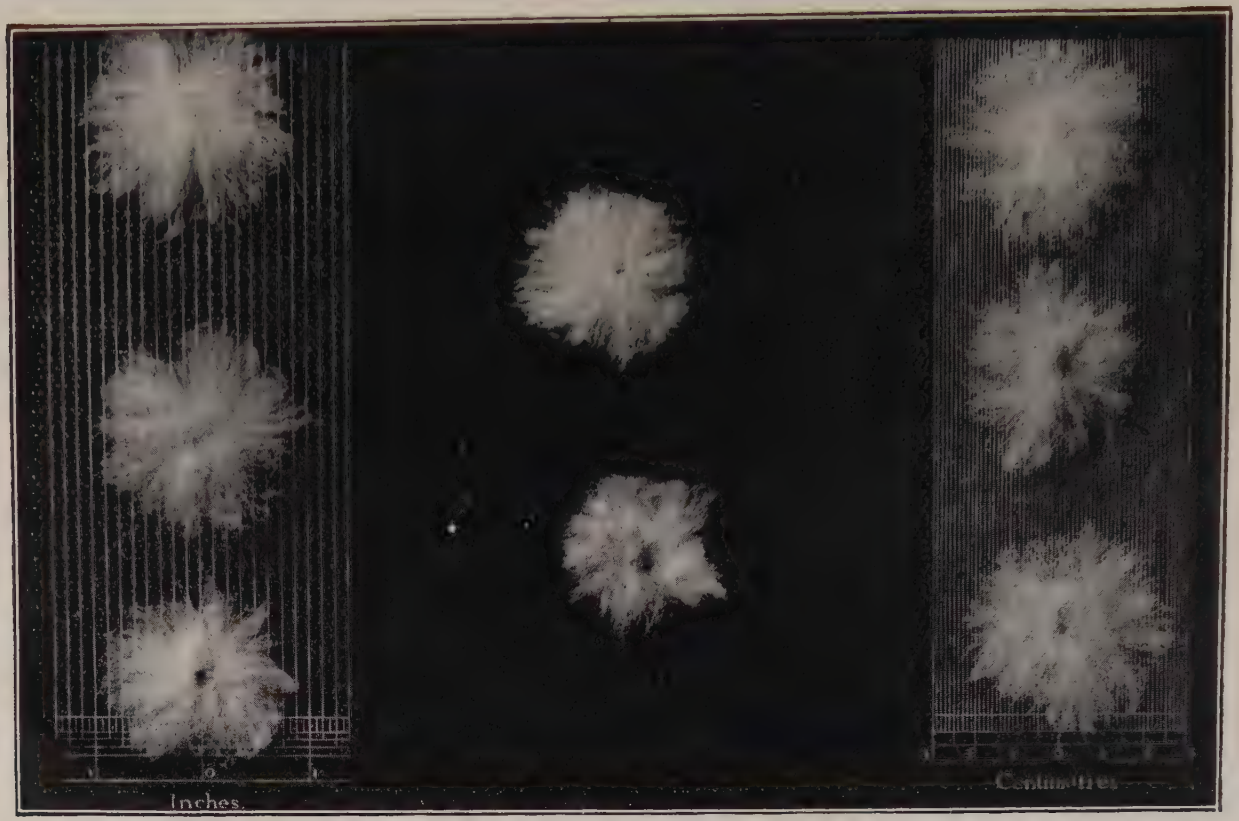
See also *Mutation in Egyptian Cotton* by T. H. Kearney in *Journal of Agricultural Research*, Vol. II, p. 287.

PLATE I

A. Plant of F1 generation of the Peruvian-Upland cross.

B. & C. Mysore-American IV from F5 generation.

PLATE II



Combed seed of cotton of Mysore-American IV.
In the centre local Doddhatti.

petal spot, the characteristic feature of the Peruvian plant was dominant and the shape of the leaf and of the fruit of the Peruvian plant were also dominant. In F 2, F 3 and F 4 generations, plants were in a heterozygous condition. In F 5 (Plate I figs. B. and C. See also Plate IV fig. B.) we found the progeny of a plant (lines 249—254) practically fixed. This gave a ginning out-turn between 32 and 36 and when a sample of it was submitted to the Mill for valuation, the following report was obtained :—

"We find the sample cotton is superior to Davangere Doddhatti cotton as it is very clean and possesses a longer and finer staple with a better natural twist in it (Plate II). This should, we think, fetch at least 5 per cent better rate than the Davangere Doddhatti."

This has been designated as Mysore-American IV.

Discussions on some of the Results achieved.

Although this paper is of a general nature and does not go into details, yet there are a few points which, in the nature of things, warrant brief discussion. It has not been found possible by many breeders to obtain and fix up desirable recombinations from hybrids. In fact, O. F. Cook has discussed this question in detail in his paper, "Heredity and Cotton-breeding". He says:—

"For three or four generations some individuals continue to show resemblance to the superior first generation hybrids, but progenies of such plants are diverse, like those that are obtained from the so-called heterozygotes in a typical Mendelian hybrid. The other plants that correspond roughly to the homozygotes of Mendelism return to the expression of the characters of the parental stock, in different degrees and combinations."

On the other hand the work of Thomas H. Kearney has proved that it is possible to fix a superior variety of cotton through hybridization. For, he says,* "The data here presented concerning the correlations of characters in the Holden-Pima hybrid indicate that freedom of recombination in hybrids between Upland and Egyptian cotton is much less restricted than Cook supposed and evidence is also given that even as early as the third generation the new combinations may be relatively stable." Further on, he says, "The practical breeding work with Egyptian cottons has afforded evidence that it

* Kearney : Segregation and Correlation of Characters in an Upland-Egyptian Cotton Hybrid, p. 50. (U.S. Department of Agriculture, Departmental Bulletin 1164.)

may not be extremely difficult to combine the desired characters of two such varieties in a stable and uniform type."

As stated above we have been able to fix a type this season and what is more, some more promising forms are in the course of being fixed.

Mention has already been made about the relation between the shape of the fruit and the length of the lint.

Cook* draws attention to "a very general correlation between the shape of the boll and the length of the lint running through all the varieties that have been studied with this idea in mind, plants with more rounded bolls having shorter lint."

Thomas H. Kearney says: "That in Egyptian cotton, although extremely long, narrow bolls sometimes contain inferior fibre, very short, rounded bolls are never correlated with long lint."

As already mentioned the object of this work was to fix a variety possessing long and narrow bolls and though this object has been realized (See Plate No. III), yet it must be admitted that there have been instances in the course of this work, where very short and inferior fibres have been found in long and narrow fruits.

The last point that we have to consider is about the shape and size of the bolls. An upland type having a small round boll was crossed with a tree cotton with long, narrow boll. (Plate IV Fig. (1) A.) In F 3 and later generations we got the following:—

1. Long and narrow as in the male parent.
2. Round and small as in the female parent.
3. Long and broad—extra-parental character.
4. Round and big—another extra-parental character.

The question naturally arises as to how the last two forms developed. Cook says†: "That hybridization often has the effect of including wholesale reversion or reappearance of ancestral characters has been recognized in such well-known cases as the blue hybrids produced by crossing two white varieties of pigeons.....Such atavistic reappearances of more primitive characters seem to be almost as frequent as.....the phenomena of hybridization." In another paper,‡ he describes three different kinds of characters

* Cook: Suppressed and Intensified Characters in Cotton Hybrids, p. 14. (U.S. Department of Agriculture, Bureau of Plant Industry, Bulletin No. 147.)

† Heredity and Cotton-breeding, p. 59. (U. S. Department of Agriculture, Bureau of Plant Industry, Bull. No. 2561.)

‡ *Loc. cit.*, p. 1.

PLATE III

Plant from F5 generation having a long big fruit
which is an extra-parental character.

PLATE IV

A. Tree cotton which was used as the male parent.
B. Mysore-American IV—Sixth generation.

A. Flower with a very long style.
B. Flower with a bent style.

of hybrids and sub-divides one of them which he calls extra-parental characters into three kinds, (*a*) suppressed, (*b*) intensified, and (*c*) primitive, characters.

In a very recent paper* of his, T. H. Kearney has given a list of the extra-parental characters he found in F 2 of the Holden-Pima hybrid. Kearney, it seems, has not found any change in the shape or the size of the fruit, outside the parental forms. Anyhow it seems to the writer that the two new extra-parental forms are intensified characters. It may be mentioned that of the extra-parental characters observed by Kearney the two characters that we have noted in our cross are :—(Plate IV Fig. 2.)

1. Pistil exserted in the bud. a character sometimes associated with malformation of corolla.

2. Stigma bent sometimes at a right angle to the column.

Agriculture in the Kolar District.

Presidential Address by Dr. Leslie C. Coleman, M.A., Ph.D., at the Kolar District Conference held in May, 1924.

Mr. Hiriannaiya, Mr. Gopala Rao and Gentlemen,

It is now several years since I had the honor of presiding over the Agricultural Section of your District Conference. I always value greatly these opportunities of meeting representative gentlemen drawn from all parts of the District, because with the growth of executive work, I have found it increasingly difficult to make detailed personal surveys of the work that is being done in connection with agricultural improvement.

The one agricultural factor which has overshadowed all others during the past year has been the very unfavourable weather conditions. With conditions such as have prevailed, it is useless to expect rapid progress. I cannot hold out any hopes to you of our being able to supply you with seed which will grow and produce a good harvest without rain nor shall be able to develop for you a type of bullock which will live and work without fodder. You are, I think, as a district, to be congratulated upon the manner in which you have met the situation. You have been able in one way or another to keep a large proportion of your cattle alive and the failure of

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* *Loc. cit.*, p. 40.

water supply in your tanks has led to a campaign of well sinking which is, I believe, unprecedented in the history of the State. If the rather disastrous year through which we have passed has firmly impressed upon our minds the necessity of providing subsidiary sources of irrigation on a large scale upon which we can fall back when our tanks fail, it will certainly prove to have been a blessing in disguise.

The question of well-sinking in Mysore is always a difficult one. Situated as we are on a high plateau we cannot hope to have that cheap and easy system of well irrigation which prevails on the coastal plains of Madras. To dig a well in Kolar District means almost invariably a fairly large expenditure of money. More than that it requires a great deal of judgment and foresight if the money so spent is not to be wasted. Many cases have come to my attention where a ryot after spending considerable sums of money in sinking a well has had to abandon it, because he has encountered a rock before he struck any adequate supply of water, or because the sides collapsed, or because no water was reached within a depth which would allow for irrigation on an economic basis.

Under the orders of Government, the Agricultural Department has, during the past four months, made the beginnings of an organization to help ryots in this difficult work. We have a staff of one well-boring operator with a mechanic to assist him, and they are provided with a Musto boring plant and ordinary hand boring tools. This staff has been engaged in the Goribidnur and Chikballapur taluks and has, I believe, done some really useful work in assisting ryots firstly, to decide just where a well should be sunk and secondly, to sink new wells or deepen those already existing. This is of course but a small beginning. I am betraying no secret when I say that the Government, under whose instructions this work has been started, is particularly anxious to see the important work of well-sinking develop in the State, and I have strong hopes that before long we shall be able to develop a much more adequate organization to assist you in this matter.

A note of warning should, I think, be sounded here. A number of landholders whom I have met in the course of my inspections of well-sinking, seem to be under the impression that when bore holes are sunk in the bottoms of their wells, water is certain to stream

up into their wells and their troubles will be over. All the evidence which we have at present goes to show that this will rarely happen in Mysore. Boring is a comparatively cheap method of ascertaining whether it will pay you to deepen your old well and how much you will have to deepen it to get an adequate supply of water. It will also tell you when you are sinking a new well, whether sinking in a particular spot is likely to give you a good supply and will enable you to estimate pretty accurately before-hand just how much you will have to spend to get that supply.

There is much more to be said on this subject. But I am not a well expert and should prefer to reserve my remarks till we shall have been able to investigate the question much more thoroughly than we have done at present. There is undoubtedly very much still to be learned with regard to our underground water supplies, and additional information can be obtained only after careful work on the subject.

I should like to turn now to some of the older activities in this District with regard to the improvement of agriculture. The bad year through which we have just passed has furnished a very severe test of the merits of H. 22 ragi which was introduced into this District some seven years ago. Its drought resisting qualities have been signally demonstrated as has been shown by the report already read. I have little doubt that, as a result of this, the area under this variety will extend even more rapidly in the future than it has in the past. It has already reached such dimensions as to make it impossible to estimate accurately the area under it. This year there will undoubtedly be difficulty in securing an adequate supply of seed. The Agricultural Department will do all it can in this regard, but I trust to the co-operation of growers of H. 22 in helping us to meet the demand that is certain to arise.

It is particularly gratifying to know that co-operative effort towards agricultural improvement is making steady progress in this District. Not only have you nine co-operative societies definitely organized for the development of agriculture, but an increasing number of credit societies are taking up the work of stocking seeds, implements and manures for supply to members and other agriculturists. The Registrar of Co-operative Societies is taking very great personal interest in this matter and our thanks are due

to him and his department for the progress that has been made. If we could enlist the services of all your rural co-operative societies, the work in connection with agricultural improvement could be increased many-fold.

I should like to say a word about your Sheep Breeders' Association. As you know, this is the only association of its kind in the State and I look for great things from it. It is still in its infancy and the seasonal conditions during the past year have been as unfavourable as they could have been, yet its membership is growing. We have unfortunately had to take away temporarily the Inspector, who was deputed to assist in developing the Association's activities for work in connection with fodder scarcity, but I hope that we shall soon be able to return him to you and that during the coming year we shall be able to show marked progress in connection with sheep improvement.

The development of Sericulture in this district has been severely handicapped by the shortage of irrigation, otherwise undoubtedly there would have been a great expansion. One of your District Board members, Mr. Hampaiya, has been chosen to represent Sericulture on the new Representative Assembly and I am sure he will do his best to see that this important industry develops not only in Kolar but in other parts of the State as well. Considering seasonal conditions the number of layings, almost 80,000, distributed indicates distinct appreciation on the part of silkworm rearers of the work the Sericultural Department is doing. The trials of rearings of the new varieties of silkworms evolved by the late Sericultural Expert, Mr. Yonemura, are distinctly promising. Another new item of work which may lead to great progress is the trial of the improved domestic basin unit which the Department imported from France. I look for distinct development in this work during the coming year.

Finally, I wish to say a few words on a subject which is of very real interest to you at the present moment. I refer to the fodder question. I discussed this subject very thoroughly with your District Board about two months ago. Since then, fodder conditions have certainly not improved, and I think it would be over-optimistic to expect them to improve very greatly for some months to come.

The Agricultural Department has been doing all it can to help you to meet the situation and Government have been very generous

in placing funds at our disposal for this purpose. However, you will, I am convinced, have to make very special efforts if you are to keep your work-cattle in a condition fit to carry out necessary work during the next few months. A large amount of paddy straw (over 300 tons) has been sold in the Goribidnur fodder depot and about 75 tons of Malnad hay have already been shipped or are being shipped all across the State to help feed your cattle. This work of supplying fodder will be carried on as rapidly as possible and will continue till our available supplies are exhausted or till the need is over. I am unable to predict which of these two contingencies will put an end to the supplying of fodder,—I hope, with you, the latter.

This fodder is being sold at concession rates, which entail a considerable loss to Government. It is, I consider, your duty to husband these supplies and other supplies which you may have to the fullest extent by making use of subsidiary fodder sources. An extensive campaign has been carried on during the past three or four months in this District to teach your ryots how prickly pear can be used as fodder. This campaign has had some results, but I think not the results which it should have had. It must be admitted that preparing prickly pear for fodder purposes is a rather troublesome and tedious job, but it undoubtedly can be done and that at no great expense outside of labour. I wish to impress upon you again the folly of trusting to Providence in the matter of fodder supply and would strongly urge upon you the necessity of utilizing prickly pear now so as to enable you to husband your regular fodder supply. If your supply of straw and grass becomes exhausted you will not be able to maintain your animals on prickly pear alone, and if the stocks of fodder which have been collected with great labour and at considerable expense, become exhausted, as may quite possibly happen, we shall not be able to help you further. I wish therefore to sound a very serious note of warning to you in this connection.

I look upon Kolar District as agriculturally one of the most progressive in the State. That is, I believe, in no small measure due to the fact that you have to work for what you get. Were your seasons more kindly and were your soil more fertile you would not have that incentive towards improvement which you now have. You have co-operated with the Agricultural Department in a way

few other districts have done, and I wish to thank you for that co-operation without which our work would be a complete failure. Notwithstanding unpropitious seasons, we are going ahead and I am sure that the agriculturists of this District will face the future with that steady courage which has characterized them in the past.

Agricultural Production in Mysore and How to Increase it.

BY

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In his address to the Representative Assembly at its Dasara Session in October, 1922, while speaking of Food Production in the State, Mr. A. R. Banerji, the Dewan of Mysore, said that the annual food requirements of the population were 2,192,000 pallas of rice, 7,685,000 pallas of ragi and 1,315,000 pallas of jola whereas the total production of all these together in the State itself was only 8,147,968 pallas—thus showing that the production was less than the quantity required and necessitating an annual import of nearly 3,000,000 pallas of food grains.

According to statistics given by Dr. Leslie C. Coleman, Director of Agriculture in Mysore, in his notes dated the 8th February 1922 and 7th August 1917 on Agricultural Production in Mysore, the average annual home production of these food grains between 1905-15 and 1915—20 is as follows :—

Period	Out-turn in Pallas		
	Ragi	Paddy	Jola
1905—15	5,592,034	4,178,639	1,178,296
1915—20	5,260,656	3,766,534	1,040,058

Comparing with each other, the figures for production and consumption, it is seen that over two million pallas of ragi alone are to be imported annually to satisfy the total requirements of the population. This means that the home production has to be increased by nearly 40%. The position with regard to rice is not so serious. The production is about four million pallas of paddy or 2 million pallas of rice and the demand exceeds production by nearly 200,000 pallas

i.e., by 10%. The production of jola is about 1.1 million pallas and this has to be raised to 1.3 million pallas or by nearly 20%. Thus it is seen that it is the increase in yield of our dry crops that demands our attention most.

Statistics given by Dr. Coleman in his notes above referred to, show that during the period 1905—15, the annual production of ragi from 2.24 million acres amounted to 5—6 million pallas. From these figures, the average yield of ragi works out to 2.5 pallas per acre. The average yield calculated in a similar way for the period of 1915—20 does not differ much from the average for 1905—15. The average yield of jola per acre during 1905—15 works out to 1.9 pallas and that during 1915—20 to 1.6 pallas. In the case of paddy the average yield per acre during 1905—15 works out to 5.7 pallas whereas it is only 5 pallas during 1915—20.

That the average yields per acre are rather low, will, I think, be easily admitted by the majority of us. We all know that there are vast stretches of land which produce 3 to 4 times this average yield. For the average yield to be brought down to such a low level as given in the previous para, there must be a very large area of land producing a crop much below the averages given. A good deal of information will have to be collected to find out exactly the extents of land yielding below and above these averages.

How is it then possible to increase production ?

There are two ways of doing this—one is to increase the extent of land under cultivation and the other is to increase the yield of lands already under cultivation.

According to the note by Dr. Coleman referred to above the net area cropped during 1915—20 has increased by 236,000 acres as compared with the same during 1905—15. In spite of this increase in extent, production has not kept pace with demand for food grains. It is not an easy task to bring new land under cultivation, for it requires capital, labour, implements as well as live-stock. Hence increase in this direction is bound to be slow. The increase during 1915—20 over the cropped area in 1905—15 has only been 4%.

The other alternative to increase agricultural production is to try and produce most out of land under cultivation. That our lands are not of high productivity is easily seen by a comparison of yields

of wheat in the various countries of the world with that in our own as given below:—

England ..	..	8.8 cwts per acre.
Germany ..	..	8.0 do.
France ..	..	5.4 do.
Austria ..	..	5.0 do.
India ..	..	2.8 do.

The figures show that, with regard to quality of agriculture, England still keeps the lead. Good cultivation, combined with selection of seed and heavy manuring, has been the real basis for such high yields.

So the means to be adopted to increase production of lands already under cultivation are the use of improved implements, better quality of seed and special manures to suit the various types of land and the crops grown on them.

The question of the introduction of improved implements and seeds has already been dealt with by Dr. Coleman in his notes referred to above, and so I shall confine myself to the question of manures.

The one universal manure fit for every type of land and every kind of crop and used by all farmers in the world is farm-yard manure. The yield of crop from its application depends on the quantity and the quality of it applied. The quantity produced is limited by the number of domestic animals which a farmer can maintain, whereas the quality depends upon the nature of animals, the feed given to them, and the care taken to preserve the manure produced by the animals.

The quantity of farm-yard manure is not generally sufficient to adequately manure the whole area under cultivation. Moreover, farm-yard manure being a general manure in which all plant foods are contained in certain proportions, it is not possible to cater to the needs of individual crops and types of land by using that alone and no other manure. Moreover, the general trend of opinion now-a-days is to value farm-yard manure not so much for its fertilizing ingredients as for its mechanical and biological effects upon land.

It may be asked if there is any necessity to manure land at all. It is quite true and within the experience of every practical agriculturist that under the ordinary system of cultivation, every bit of land is capable of producing a certain amount of crop without the application of any manure at all. The decompositions and changes

set up in the soil during and between the various cultural operations together with the root residues from previous crop furnish plant-foods for a certain amount of crop. Under these conditions, the land is said to have reached its lowest limit of fertility or "minimum cropping value". The yield from such un-manured fields varies within narrow limits from year to year, and the best example of it is the un-manured wheat plot at Rothamsted, in England. That plot has been without manure of any description since 1839 and has, during the 50 years between 1862 and 1911, produced annually a crop of 12½ bushels of wheat per acre whereas it produced 17 bushels an acre annually during the period 1844—1851.

The quality of farm-yard manure generally produced in this country is not so good as that produced in Europe, and the majority of our lands manured inadequately with a manure of indifferent quality for a large number of years seem to have reached a pretty low level of fertility. The only way to restore their fertility and get an increased out-turn per acre is to supplement the available farm-yard manure by other manures which are industrial bye-products or manufactured specially for use in agriculture.

This is not the place to go into a detailed description of such manures, but something may be said about their use in general. It is not on every type of land that they can produce good results. Lands in a high state of fertility do not adequately respond to the use of such manures, and it does not pay to use them on lands of very poor quality. It is only on lands which are in a good state of tilth and whose productivity has gone down that their use is likely to produce good results.

Experiments conducted during the past four years have shown that groundnut and castor cakes, sulphate of ammonia, superphosphate and sulphate of potash, either singly or in suitable combinations, are the manures which can profitably be used for ragi, paddy and sugarcane. Of the above manures, the oil-cakes are produced largely in the State alone, but the major part of them is exported. The only effective way to prevent such export is to popularize their use and create a demand for them here alone. Sulphate of ammonia and superphosphate are now manufactured in India to a certain extent.

The difficulty is not in the supply of these manures, but in bringing

them into use by the majority of cultivators. Though a certain amount of propaganda and demonstration work has been done to bring home to the cultivator the advantages to be derived from a use of these manures, yet a great deal more remains to be done through those who ought to be looked upon as the medium of communication between a Government Department and the actual cultivator.

The illiterate small peasant proprietor with a holding of not more than a couple of acres in extent and without the necessary capital and rightly conservative by nature just like his brethren all over the world cannot be expected to take to the use of new implements, seeds and manures in the near future. Before he can do so after seeing the demonstrations of a Government Department, his neighbours who have some capital at their disposal and who are in a position to discuss and appreciate the new methods must take to them and lead the way. That class of "gentlemen farmers" with the necessary education, capital and enterprize so often to be met with in Europe is conspicuous in this country by its absence. There are of course big landlords, but they have either leased out their lands or live upon the taxes which they can collect from their tenants. Farming is not their profession but banking among their tenants is surely done by them and that, not at any reasonable rates of interest.

There are two ways in which the absentee landlords get some return from their property. The first is by leasing out their lands to some cultivator for a rental in kind and the second is to allow the land to be cultivated on the share system. Both these have certain inherent defects. In the first instance the lease usually runs from year to year which does not give the cultivator any permanency of tenure. He has therefore no interest in maintaining the fertility of the land, and consequently the land very soon comes down to its minimum cropping value. Even in the second system, there is no permanency of tenure. It being the custom for the owner to supply seed and manure under the share system, the owner of the land is not generally willing to invest money for manuring the land as he is always afraid of being cheated by the tenant and not getting his legitimate half of the produce. As a consequence of the neglect of both landlord and tenant the fields continue to go down in fertility and soon reach the minimum limit of it.

The lot of even the peasant proprietor with enough land at his

disposal is not quite satisfactory to enable him to invest money on artificial manures. The lands of his holding do not always lie in one compact block and this makes it very difficult for him to make the best use of his own energies and those of his family.

Most of our irrigated lands are badly in need of drainage to prevent them from getting saline in course of time. The owners of land in an irrigated tract can no doubt drain their own lands but a common drainage channel to carry away the water from drains in their lands is always conspicuous by its absence.

Consolidation of holdings and providing facilities for drainage can be brought about either by co-operation or by legislation. What co-operation without any legislation can achieve in consolidating holdings was amply illustrated by the Registrar of Co-operative Societies in the Punjab at the recent Meeting of the Imperial Board of Agriculture, in January 1924. He had succeeded in raising the size of a holding from 0.6 of an acre to 6.2 acres by co-operative consolidation. As a consequence the area of waste land had decreased and the value of land itself had risen contributing materially to the benefit of the actual cultivator.

Some legislation is necessary to regulate the relations between absentee landlord and his tenant so that the fertility of the land is not allowed to suffer. The cultivator must be assured of occupancy for about 10 or 15 years at least, and the absentee landlord who gets his land worked on the share system must take care to provide manure for his lands. This certainly means some annual outlay on his part, but he can be certain of more produce and a decent net profit on his investment for manures as well. Absentee landlords whose lands are being cultivated on the share system seem to be realizing their duty with regard to supply of manures and since they cannot buy farmyard manure in quantities sufficient for their purpose, they are slowly seeking advice with regard to the use of artificial manures for crops like paddy and sugarcane.

It does not want any elaborate preparation to market cereal crops after they are harvested. A crop like sugarcane requires attention not only during its period of growth but also when it is being harvested and converted into marketable commodity. From investigations conducted by the Department. it can safely be assumed that about $\frac{1}{4}$ of the sugar contained in the cane grown is being burnt

away in the refuse from the crushing mill. In addition to this loss due to defects in milling cane, there are other sources of loss which occur during the boiling of juice into jaggery. In many parts of the province, the cane-growers themselves do not own any mills and pans. They usually hire them out from their landlords or petty merchants in their villages, or are dependent on itinerant gangs of mill men with their paraphernalia of mills, buffaloes and pan. If they cannot get milling facilities in time, they are bound to allow their cane to stand in the field even after the crop is ripe. and suffer losses consequently.

Some years back, an attempt was made by Government to remedy some of these defects by establishing power-crushing mills and big jaggery-making equipments in representative cane areas. Cultivators were induced to have their cane milled at the factory and pay a fee for every maund of jaggery manufactured and given to them. The arrangement did not unfortunately prove a success and did not consequently benefit the ryot. The factory had no interest in the quality of jaggery made and the ryot did not always supply good cane to make the undertaking a success. On the other hand, if the factory had only undertaken to mill the cane charging a fee for every panful of juice supplied and given all facilities to the owner of cane to boil the juice into jaggery, then it would have been to the interest of the ryot himself to supply good cane to the mill so that he might get good jaggery for the boiling of which he was himself responsible. As it was, the ryot simply thought that it was the duty of the mill people to make good jaggery from any kind of cane. There seems to be a lot of scope for a jaggery factory established as a co-operative concern in which only the cane-growers are the share-holders. Then it will be to their interest to make the thing a success and get the profits also for themselves.

This paper has not been written to put forward before the public any cut and dry scheme for increase of agricultural production, but only to stimulate thought and devise ways and means after a thorough discussion of the situation at present and the difficulties involved in working out a practical scheme on a large scale suited to the conditions of our State.

Production of Silk-worm Seed.

BY

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Seed production is one of the most important problems connected with sericulture, and a problem also which the people engaged in the industry seem unable, unaided, to solve. The vicissitudes in the history of sericulture, in Mysore at least, have been directly the result of bad or insufficient seed. This is undoubtedly a branch of sericulture in which a certain measure of State control and interference is not merely beneficial but absolutely necessary. In Japan, the State controls seed supply and penalizes the issue of seed not conforming to the very carefully thought-out regulations which govern seed manufacture. The State has grainage stations which supply original seed to licensed seed manufacturers. These stations are constantly at work fixing new races or investigating new hybrids which might advantageously be tried in each locality; and through them, research and practice are kept intimately connected. The seed manufacturers rear with the original seed supplied to them, and their rearings are inspected in their progress by authorized State Inspectors. The seed is manufactured with the cocoons reared with selected original seed under careful supervision, and is subjected to a severe test before being finally passed. The State does not expect to make money on this part of the work, but considers itself amply rewarded by the phenomenal growth of sericulture in recent times.

In Mysore, there is a system of Government Grainages working hand in hand with selected rearers of seed cocoons. The object is to ultimately approximate to the Japanese system by fostering the development of private or aided grainages working under the control of the Sericultural Department, and in close co-operation with it. For this purpose, a number of concessions have been sanctioned to encourage people with some measure of education to take up the manufacture of silk-worm seed as a profession.

In regard to the manufacture of seed, there is a tendency to attach overwhelming importance to the part of the work that takes place in the grainage, starting with the arrangement of seed cocoons

and culminating in the microscopic examination of moths. These operations are no doubt very important, and it is true that a grainage without proper equipment and an efficiently organized and scientifically correct technique, is a good deal worse than useless. But the best equipment, and the most correct technique, will not get seed out of bad or indifferent seed cocoons—and seed cocoons, we know, are not produced in the grainage, but in the rearing room. To arrive at a just notion of the importance of the examination part of the grainage work, it would be as well to know its scope and its limits—what it can do, and also what it cannot do.

Microscopic examination can disclose the existence of pebrine, flacherie, grasserie, and muscardine. As a matter of fact, only the two former are of importance in the grainage, as worms affected with the two latter seldom spin cocoons, and never reach the pupal stage. Pebrine in the mother moth is no doubt an almost certain indication that the progeny is infected, and flacherie though not transmissible to offspring in the same way, is an index of feeble health in the mother such as would disqualify her progeny from being selected. Therefore, the seed that has been passed after a rigorous microscopic examination may be safely said to be free from pebrine and flacherie ; but this freedom by itself does not make good seed. We must also know something more—about the seed cocoons used—before we can say the seed is good. How did the worms which spun the seed cocoons behave during their progress ? What locality did those cocoons come from ? Were the worms healthy and vigorous ? Were they well fed on good rich mulberry leaves ? Were the cocoons well shaped ? Are the cocoons in that locality normally rich in silk ? These, and a number of similar questions have to be satisfactorily answered before the seed can be confidently recommended as healthy, robust and of good stock ; the microscopic examination only enables us to add—"*and also free from detectable pebrine and flacherie.*" Unusually, skilful raiyats pay a detailed and really scientific attention to these facts. They generally select as their suppliers good rearers owning ample mulberry gardens and presumably commanding a sufficient supply of good leaves, showing a marked preference to those who have a history of successful seed-rearing to recommend them. They see the worms occasionally during their progress, and particularly during the last stage when they are about to ripen. They even watch

the mounting. If the behaviour of the worms that they see, and the history of the worms that they hear, satisfy them, they buy the cocoons for seed ; not otherwise. The selection of seed cocoons is perfect, and worthy of being copied but after the cocoons are bought they are sometimes not well kept, with the result that sometimes fermentation sets in and flacherie is induced ; moths are paired promiscuously in one seething fluttering mass which overflows the crowded tray ; the eggs are kept anyhow, and all the operations are exposed to a hundred chances of contaminative infection.

The good graineur, then, should select seed cocoons like a clever raiyat, and proceed with the subsequent treatment like a trained sericulturist, with care, cleanliness, and correctness of technique. A good arrangement for a graineur who cannot rear his own seed cocoons would be to select good rearers of seed cocoons, give them carefully prepared cellular seed, and buy their crop for the grainage. With this system, it has been found possible to get seed cocoons practically free from pebrine.

Report on Trial of the "Mysore" Plough.—1923.

BY

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I have not given the plough a dynamometer test under either share, but as far as one can observe there is no difference in draught between the two. The flat share was tried in stiff sod on both clay and sandy loam, and it was very noticeable that the roots entered between the bar point and its union with the side of the flat share on the furrow side, where a slit is formed, into which the roots rapidly accumulate. This took place quite rapidly in heavy sod, consisting of mixed grasses, in which marvalli grass was quite conspicuous, and in less than 20 yards affected the penetrating qualities of the plough. Frequently the roots became so tightly wedged into the slit that difficulty was encountered in removing them. I may say that the same difficulty has been encountered in the use of the Sabul plough under the same circumstances. The latter plough has the same kind of a flat share. No difference was noticeable in this feature, when the

nature of the soil changed from stiff clay to a sandy loam. With the other type of share supplied with the plough, this difficulty was not encountered, although I personally held the plough for several rounds and tried to obtain such a result if possible. This seems to be due to better fit in the case of the latter share, as well as a difference in the contour. It is conceivable that a badly fitting share of the 'ordinary' shape would behave even worse than the flat share as there would be thus two places for the entry of roots, as one on each side of the bar point.

On red land, there is no difference in the behaviour of the plough with either share. I have been unable for several reasons to personally try the plough on a light sod such as would be found after two or three years on neglected cultivated land. If opportunity offers I will do so and report at a later date. One of the reasons mentioned above which rendered it impossible for me to give the plough a more thorough trial was the fact that the beam broke three times (being replaced each time by a new one) under the stress of ploughing heavy sod. The point and manner of fracture was the same in each instance. This leads me to suppose that the line of draught is not properly placed, and that better results would be obtained if the beam were so placed that it would make a greater angle with the horizontal than is now the case. This could be accomplished by causing the handles to be attached lower down, and need not alter the design of the plough in any other respect. I had hoped to find time to make some experiment in this direction, but have so far been unable to do so. The alteration in fitting the beam has since been made, but no opportunity has occurred on which a proper trial could be made, and a bolt has also been put through the rear of the beam in an up and down direction with a view to avoid splitting.

There is a third point to which I may be allowed to draw attention. The landside, as at present designed has no sole, the wear at this point being taken almost entirely by the casting of the body itself. In gravelly soils, it is conceivable that this wear might take place to such an extent as to cause the necessity for frequent renewal of the body, or at least to upset the suction and penetrating qualities of the plough. A glance at such ploughs as the Verity or Sabul will show the presence of a sole on the landside, especially heavy in

the case of the former. I suggest that by slightly decreasing the depth of the body casting at this point, it would be possible to accommodate a landside which could carry a right angle bend, thus providing a single sole and providing for replacement at this point, for which the plough at present does not allow.

A Serious Pest of Cardamoms.

BY

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Year after year for the past four or five years swarms of caterpillars have appeared on cardamom in Sakleshpur, Mudigere and neighbouring taluks, causing heavy loss to the growers. They were not noticed during the hot weather, but after the rains they were first seen in small numbers which, later during the cold weather, swelled into many millions. They start apparently in the forest, multiply there and defoliate practically every tree in the locality and when there is nothing more left to feed on, descend by long threads on to the cardamom and strip the leaves to the midribs. They do not appear to feed in the day-time when most of them may be found congregating in masses on the trunk of the trees, in the hollows of decayed logs or in other shelters to be found elsewhere. As soon as it darkens—sometimes a couple of hours earlier—they scatter, work their way back to the crop and feed on it all night.

The caterpillars are all of them wooly and more or less slaty or dark blue in colour with lac-red heads, stripped or mottled yellow. The body markings vary but usually there are lateral stripes with dark blotches on the back. These are, however, obscured by the numerous hairs, grey, dark or blue. These hairs are easily detached when touched and are poisonous causing irritation of the skin but nothing more serious. It is these hairs that give to the collections of worms the appearance of a blanket.

The caterpillars when full grown spin a thin dirt-coloured cocoon and turn into shining black inside. The moths emerge out of these. Very few have been successfully reared out. It is not possible, therefore, to determine their correct identity. Possibly they are *Euptorte*

minor that appeared in similar swarms in Burma several decades ago. At any rate the habits are similar.

The havoc caused is extremely severe and since it has appeared several years in succession something has to be done to control the pest. The start that it has in forest areas makes it difficult to locate it in the initial stages when control should be easy. The only resource left until more information can be obtained is to deal with it when it appears on the cardamom crop or in the immediate neighbourhood. Since the caterpillars remain together in masses in the day-time it should not be difficult to deal with them there. They could be burnt off with torches but there are obvious objections to the use of torches in estates with plenty of dry leaves and logs about. Two other methods were tried—one by spraying the colonies with kerosene and strong kerosene emulsion. A small tin syringe provided with a fine rose which can be made at a cost of eight annas would do or a hand syringe of brass strongly made could be obtained at a cost of about Rs. 7. The operation is easy and enormous numbers can be killed off easily. The other method is to dust the caterpillars with cyanide powder mixed with cyanide dust. chalk powder or any other fine carrier. The powder will lodge easily amidst the numerous hairs and the gas evolving would kill off caterpillars quickly. Both these methods have been tried and found effective but there are some difficulties. Not all caterpillars leave the cardamom to congregate in the situations described. Some remain in the under-side of the leaves where kerosening is out of the question, and dusting would be tedious without a duster but the number of such caterpillars is small and injury they may do may not be serious if caterpillars elsewhere have been accounted for. The more serious difficulty is that the invasion is sometimes in such countless hordes that even if all the masses in accessible situations have been killed off, there may be still many millions left on the trees above which may descend and complete the havoc. Spraying the cardamom with a stomach poison will avail little, for a whole crop so sprayed may poison but a fraction of the caterpillars. A repellant which when sprayed would keep them off the crop would be all right. But several were tried and found useless. There is some hope of one proving useful but further tests have to be made to prove its worth. Even if it is found satisfactory it is not many owners who can find the labour to distribute it over the plants. It

is likely, further more, that rains may not allow it to retain its property long. It seems, therefore, almost impossible in the present state of our knowledge of the pest to do anything useful if the caterpillars invade in many millions. But if they are in less formidable dimensions, as fortunately they are usually, the simple remedies described above of kerosening or dusting would suffice. For a few days when the damage threatened appears imminent the watchman usually stationed to look after the crop should be instructed to deal with the masses of caterpillars in the way described. Those that are found to remain on the cardamom may be dusted with cyanide or may be disturbed off when they also will try to congregate in situations where they can be more easily dealt with. It is possible also that thinning out the shade above the crop may make the shelter of cardamom leaves unattractive to the caterpillars by the greater heat and light which it would let in. This, however, has yet to be tested.

The Department is continuing its investigations of the pest and further trials with repellants and other remedies will be made as soon as opportunity offers. In the meanwhile, it would urge on such of the members of the Union as own cardamom to test the remedies described and report results to the Department. A limited quantity of cyanide and carrier will be distributed free to them on request with full instructions as to how it should be used.

A Visit to the Mysore Government Central Silk Farm at Channapatna.

By the Editor.

This farm is situated on the Bangalore—Mysore road about 35 miles from Bangalore, and comes into view to the traveller by road or train when just nearing Channapatna Railway Station. The farm buildings are situated on a sloping ground and appear very picturesque when viewed from a distance having a background of green clad hills.

History of the Farm :—The farm was first started during the Dewanship of Sir M. Visvesvaraya, who, in consultation with Dr. Gorio of Italy, got Mr. W. Mari as Silk Expert to the Mysore State. Just then the lands on which the present buildings

are situated were leased out from Mr. M. Abdul Quddus.—a prominent member of a family long connected with the silk trade of Channapatna—who subsequently made a free gift of it to Government and in commemoration of which a marble tablet has been put in the main building. Mr. Mari stopped here for about a year and carried on some experimental work before he went away to Italy to return as the Director of Sericulture in the State in 1916. Ever since, this farm has been the premier Sericultural Farm in the State, and even when Mr. M. Yonemura was brought from Japan as Silk Expert in 1919, he started his work in Channapatna Farm and continued to work there till 1920 when he went back to Japan. Till 1918 the rearing, etc., were being conducted in the old buildings which Mr. Abdul Quddus had given over to Government along with the land. In 1918 a new rearing house was constructed by Government and by the addition of four acres of land for a mulberry garden, the farm was made self-contained. As work developed new buildings had to be constructed and another six acres of land for garden were also attached to the farm. Just now there are three *pucca* buildings for rearing and grainage work and a few temporary buildings for reeling, stores, quarters, etc. The area of the garden attached to the farm is about ten acres.

Mr. Mari brought with him some Italian races of silk-worms and reared them here along with their crosses with the Mysore race. Unfortunately he did not continue the work long enough to get any definite results. The main work that was being done in the farm till Mr. Yonemura arrived in 1919 was that of rearing worms of Mysore race on improved methods for demonstration purposes, rearing of foreign races in certain months with eggs got from Italy and France through Cashmere and of preparing and distributing disease-free layings on a moderate scale. When Mr. Yonemura came in 1919, experimental work was again started in addition to the usual work of the farm. He also trained a few members of the staff in improved methods of work. He went back to Japan in 1920, and when he returned to Mysore a second time in 1921, he started work in Mysore City and experimental work was consequently centralized in Mysore.

With the return of Mr. H. S. Govinda Rau in February 1923 from Japan whither he had been deputed by Government in September 1920 to undergo special training in Sericulture, experimental

work was again started on the Channapatna Farm in addition to the work that was being done at Mysore by Mr. Yonemura. When Mr. Yonemura severed his connection with Mysore in September 1923, the major part of the experimental work that was being done by Mr. Yonemura was also transferred to this central farm. Experimental work is being carried on now in addition to the ordinary rearing, grainage and district work of the farm.

The work that is being done now may briefly be summarized as follows :—

A. *Rearing of pure foreign races and their crosses with the Mysore race* :—

There are at present about ten pure Japanese and Chinese races, the seeds of which had been brought by Mr. Govinda Rao, the Officer-in-charge, when he returned from Japan. The pure races are being reared on this farm since May 1923 just to test their suitability to Mysore conditions during the several months. Naturally the eggs of these races do not hatch for a long time and they can be made to hatch uniformly only when they have been kept in cold storage for a considerable time. Under these circumstances only one generation of these worms can be reared in a year. Besides, there are not enough facilities for cold storage and the cost of ice is also very high. It was interesting to learn that by treating the eggs of these races artificially, either with hydrochloric acid or hot water or electricity, the eggs have been made to hatch in ten days after they are laid just like the untreated Mysore eggs. By adopting this method, these foreign races have been reared on this farm for over seven generations during the course of twelve months. The races do not appear to have suffered in any way by adopting the artificial hatching methods.

2. *Hybridizing Work* :—

The Mysore race of silk-worm has got certain good qualities but the time taken from hatching to finish is unduly long, and the yield of silk is disproportionately small. The foreign races are rather difficult to rear in all seasons of the year but when reared with proper care, give strikingly better results than the pure Mysore race. But the difficulty of hatching the eggs of the pure races, the extra amount of care necessary in rearing these worms and the weak resistance of these worms to disease have to be overcome before the local

sericulturists can be made to rear them. With the idea of overcoming these difficulties and of combining together the good qualities of both the races, cross-breeding work was started on the farm last year and is being carried on now. The results achieved so far are very striking. Mr. Yonemura started this cross-breeding work and by inbreeding the cross-breds for several generations he has been able to select out certain races which have almost all the good qualities of pure Mysore and of the foreign races. But by trying to fix these races, certain of the desirable qualities such as the production of maximum quantity of silk, maximum vigour and activity have been whittled down. The work that is being carried on at Channapatna now is to preserve all the good qualities of both the races and get the maximum yield. This seems to be possible by rearing the F_1 of the Mysore and the foreign races. Even the F_1 of the Mysore and one of the fixed races seems to give decidedly better results than the fixed race itself. The time taken by the F_1 seems to be less than that taken by the parents, the quantity of silk produced is more and the worms also appear to be more vigorous. In certain cases, the F_1 of Mysore and a pure foreign race seems to give 80 to 90 per cent more silk than either the Mysore fixed race or the (Mysore x Mysore fixed) F_1 race. Unfortunately the seasonal conditions vary month to month and the F_1 of Mysore with a particular foreign race which gives very good results in one part of the year, may prove very discouraging in another part of the year. Before the sericulturists can be induced to take to the rearing of these F_1 worms, the particuar F_1 suited to a particular season has to be determined. It is learnt that this line of work also is being followed up now.

Some very important secondary results appear to have also come to light in the course of these cross-breeding experiments

Firstly, it is learnt that by inbreeding the F_1 races for a number of generations, say six or seven, it may be possible to get back one of the pure races which may be more acclimatized than the original pure races with which the cross-breeding work was started.

Secondly, that some of the pure univoltine and bivoltine races produce unhibernating eggs for two or three generations at a time, during some parts of the year though in their native homes they are strictly univoltine or bivoltine.

Thirdly, some worms which strictly ought to form the cocoons

after four moults, sometimes appear to do so after the third moult only.

Fourthly, it appears to be easier to fix a white cocoon-producing race than a coloured cocoon-producing one.

Lastly, to improve the existing races and to fix any race from cross-breeds by inbreeding, best results seem to have been obtained by rearing the progeny of each pair of moths separately for a number of generations and by constant selection.

Anyhow the results of cross-breeding experiments appear to be of great value from an economic as well as a scientific point of view.

B. *Grainage Work :—*

Rearing worms for seed requires special attention and before such seed is issued to the public it must be made sure that they are from disease-free moths. Work in this direction seems to be well systematized. The method prior to May 1923 seems to have been the following :—

The rings for cellular layings were arranged in rows on newspaper spread on a tray, the number of rings on each sheet of paper depending on the size of paper as well as that of the tray. At the time of the examination, the tray with the moths was kept near the preparer who put the moths into the mortar and kept some mark at the end of every five rings or five sets of rings when more than one moth was put into and crushed in the same mortar. The moths were crushed, a slide having 5 such preparations was made and handed over to the examiner indicating the first preparation to be examined on the slide. When the examiner went on with his work the preparer continued his as well. But unfortunately the preparer had to divert his attention now and then to strike off the rejected layings according to the directions of the examiner. The examiner was also at a disadvantage in that he had to see that certain layings were really struck off according to his instructions. So neither of the two could devote undivided attention to his work each being unavoidably disturbed by the other occasionally.

To avoid this disadvantageand increase the efficiency of work, certain modifications are being adopted since May 1923. Instead of the number of rings depending on the size of paper and tray, each sheet of paper has got 8 rows of five rings each. Each of these sheets is called an egg card. Ordinary newspaper sheets are divided into four

parts each, and each part is big enough to hold 40 rings and consequently there is no wastage of paper. Each egg card bears a serial number and each laying on a card is given a number as well, commencing from the top left-hand corner of the sheet and ending at the bottom right-hand corner. At the time of taking the moths for crushing, the preparer takes the moth from No. 1 and puts it into mortar No. 1 and so on. When the slide is prepared and given for examination it is placed on the tray so that the serial numbers on the tray, mortar and slide correspond.

At the time of preparation, the preparer enters the number of the egg sheet on a piece of paper called the examination card which contains all necessary particulars such as the number of dead moths, unfertilized eggs, brown layings, etc., and puts it on the egg sheet of the corresponding number. Then he takes the moths in the order of the serial numbers on the card, prepares the slide and puts it in the examination tray so that the numbers coincide in all cases. He then hands over the tray along with the examination card to the examiner. The work of the preparer with regard to a particular egg card is now finished and he is free to go on with his work further. The examiner is concerned with his work only and marks off the rejections on the examination card which bear the numbers corresponding to the layings. When the day's work is over, the rejections marked are removed from the egg card after a careful comparison of the egg card and the examination card.

Besides the advantages above-mentioned, the new method seems to be quicker than the old one in that about 50% more moths can be examined in the same time.

In addition to the items of work described above, experiments on the space required by worms during rearing are also being carried out.

Manurial experiments on the use of oil-cakes, sulphate of ammonia and superphosphate in the mulberry garden are also being carried out in co-operation with the Chemical Section of the Department of Agriculture to test their effect on the yield of leaves and the quantity and the quality of cocoons produced by worms fed on them.

Agricultural Education.

BY

Gundappa S. Kurpad, B.A.,

Vice-Principal, Mysore Agricultural School.

Any institution for the teaching of agriculture must have a definite aim in view, and must devote all its energies to attain that end. It is only when it concentrates its attention on a certain definite line of work that it can hope to attain satisfactory results. It can either train young men to become practical farmers or train them for research work in agriculture and to man the various departments of agriculture. Both of these can be done side by side, but they should never be mixed. The kind of training involved in these two cases, and the level of general education necessary in the case of students taking up these two lines of work are so different that to combine the two in a 'compromise course' seems to be an unwise procedure. It will then be a compromise between two divergent courses and cannot, in the very nature of things, be thoroughly efficient for either of the purposes. For the training of experts and research workers, more attention will have to be paid to the theoretical portion and to the technique of experimental work of all kinds. For the training of farmers on the other hand, stress will have to be laid on practical work on farms of various kinds in different localities. Extensive opportunities for touring and continuous work on a farm run as a business proposition will be absolutely essential. It is superfluous to say that those who are training to become farmers and who wish to have training in the research line can be allowed to have it if they have the requisite general knowledge for it, and *vice versa*.

Whatever purpose the institution is to serve, it seems to be a mistake to have it as an adjunct to a purely experimental farm. In spite of being repeatedly told otherwise, the students are naturally apt to mistake it for a model general purpose farm. In all cases, the school or the college must be the central idea and the farm and other necessary auxiliaries must be merely its appurtenances, at least part, preferably the whole farm being run as a business undertaking.

In institutions of the kind we usually have here it is inevitable that the proper atmosphere should be wanting to create a longing

in the students to go back and start life as farmers. The same difficulty seems to have been felt in the United States of America, and at least one State—Massachusetts—seems to have solved it satisfactorily. So long ago as 1914, the United States Bureau of Education issued a bulletin (No. 8 on "Vocational Training in the Rural High School"), describing in detail the methods adopted by the State with success in surmounting the very thorny question of so correlating the theoretical and practical portion of the education given in the agricultural schools, as to turn out farmers and not merely 'academical agriculturists'.

It was recognized that "Neither skill nor business ability can be learned from books alone, nor merely from observation of the work and management of others. Both require active participation during the learning period, in productive farming operations of real economic or commercial importance. In general, if there is a defect in the large agricultural schools which boys must leave home in large numbers to attend, it is the defect of putting too great reliance on books and observation to the exclusion, during the intensive learning periods, of active participation in the type or types of productive farming that the students intend to follow after graduation. Too great, one may almost say fatal, reliance is put on the ability of the students, once well grounded in sound theory at school, to put that theory into successful practice on their own farms, alone and unaided. The problem then, of providing for actual participation both as manager and worker on productive farming simultaneously with his class room instruction on the part of the boy in the agricultural school, may fairly be looked upon as the most startling and stupendous problem in the great field of vocational education."

"A fundamental feature of the Massachusetts plan is embodied in what has been termed 'part-time work in agriculture'. Part-time work as applied to agricultural education means that the student must spend part of the time required for his education in productive farm work, preferably at home, and part of his time at the school, the farm work and study being closely correlated by the school at points selected from season to season or year to year, and the farm work being given the highest educational value by competent school supervision. Co-operative work between the school and the farm home is the most effective known means of trying out under the

condition of individual farms over widely scattered areas, methods which have proved to be profitable elsewhere, as for example at the State Experimental Station. Such co-operation furnishes effective experimental means by which each boy can try out the merits of the farm home as an agency for producing profits when treated by the best known methods. The principles and methods taught by the school can be positively adapted by each boy to the economic conditions of the farm on which he may spend his working days. An essential feature of the home-project or part-time plan of training is the consideration of cost at all points. The boy by this method learns first of all through his experience that there can be no product without cost and no profits without excess of receipts over all expenditures. After such an experience he will not be likely to undertake a new enterprise without a serious attempt to estimate accurately his probable profit. The methods by which the boy becomes on a small scale a farmer or business man for himself give the project which he is carrying on and the school work in which he participates, a reality not otherwise attainable."

Such a scheme as the above could not be adopted here in its entirety for the simple reason that farms suitable for such a scheme are few. Some other arrangement whereby the advantages of the Massachusetts scheme can be obtained with the conditions available here must be thought of. Certain areas attached to the bigger farms could be run separately as commercial units and utilized for purposes of instruction. The colonization scheme before the Government offers a splendid solution, since it will make available excellent opportunities for students to undertake work which must be done with the sole idea of profit.

A word may be said about the place of agricultural colleges in such a scheme of agricultural education. It has already been said that there will always exist a demand for a certain number of highly trained scientific men both as research workers and as executive officers of the various departments of agriculture. These men could only be trained in a well-equipped agricultural college. It may be said that Government would not be justified in going to the expense of establishing and maintaining an agricultural college merely for the sake of a few recruits to the agricultural department. There is nothing to prevent Government preferring agricultural graduates

for the purposes of recruitment of officers to the Revenue and allied departments, especially in view of the fact that a working knowledge of agriculture will always be valuable to such officers, and further there will exist a better understanding between the agricultural and revenue departments. There is here no intention of asking Government to relax its standard of admission into the revenue and allied departments. That can continue to be as high as it now is or even higher : all that is suggested is that of all those who come up to the requisite general standard, those who possess agricultural qualifications should be preferred. If this position is accepted, there will then be no fear of running the college with half empty classes.

Again, the classes in connection with the scheme of training farmers can be run side by side with the higher course and thus the abilities of the highly qualified staff of the college could be utilized to the fullest advantage. The most highly trained and the best professors are never too good for taking in hand the training of farmers. It is deplorable that it is very often considered that for training farmers any sort of teachers will do and that the appointment of highly trained people for the purpose is so much talent wasted. This is an entirely erroneous idea—comparable only to the mentality which tolerates the appointment of very mediocre men as teachers in primary schools—and it must be strongly emphasized that the best talent available must be employed as much for the training of farmers as for the training of research men.

Results of Groundnut Varietal Tests.

The following report as regards the groundnut varietal test conducted by him was sent by Mr. B. Venkatanaranappa, M.A. :—

The groundnut crop may be said to be fairly satisfactory.

Locality.—Kalhalli (part of Jodi Raghunathapura, Dodballapur hobli).

Varieties sown.—Carolina, Mauritius, Sogatoor.

Date sown.—15th July, 1922. *Date harvested.*—1st December, 1922.

Quantity sown.—5 lbs. of each, or $1\frac{1}{4}$ measuring seers of actual seed each.

Quality of soil.—Sandy loam.

Previous history of soil.—Ragi grown the previous season ; not properly manured then.

Present cultivation.—Properly ploughed with a country plough ; sown under favourable conditions ; weeds carefully removed ; but no manure applied. Each sample of seed was sown in 3 separate alternate plots as directed. Extent of each plot about *two* guntas, so that each variety had about *six* guntas to grow in.

Harvest.—The following quantities of groundnut were obtained in each case :—

Variety	Yield per 6 guntas in seers	Yield per acre in seers	Yield per acre in lbs. after drying well
Carolina ..	124	827	833
Mauritius ..	150	1000	967
Sogatoor ..	128	853	827

The Business of Farming.

The business of farming differs greatly from the business of the manufacturer, because the manufacturer knows definitely when he commences to manufacture an article that it will be delivered and sold as such. The farmer, on the other hand, does not, as a rule, end the year's work by selling off the farm the exact article or the exact quantities he set out to produce. He may, for instance, as his judgment directs, either sell his oats as hay, or feed it to stock ; or may allow it to ripen and sell as grain as the season and prices dictate. The actual price offered for foodstuffs off the farm, is not, therefore, always the governing factor in influencing the farmer to sell his produce. In this sense the farmer, to be successful, needs to be a good man of business.—*A. I. F. Education Service,* Land Book No. 3. (*Agricultural Gazette of New South Wales.*)

NOTES AND COMMENTS.

"The Ramachandra Lift."

An ingenious substitute for a mhot than which there has not been a simpler lift in use to-day, the Ramachandra Lift eliminates the two very striking disadvantages with the ordinary mhot, *viz.*, the waste of water and the fatigue of the animals.

The water bucket in the lift fitted on the Farm is of a 25-gallon capacity and there has been found a very inappreciable spill of water while the bucket discharged its contents into the trough. The bucket is a simple cylinder with no valve or the discharging tube of the country mhot and admits of being locally repaired or manufactured.

The principle on which the lift works is one of utilizing the weight of the animal which is made to run on a trolley moving along rails laid on an incline of 1 in 3.5.

The mode of using the power has the following advantages :—

(1) The average draught of an animal being 1/7th of its weight and the effort derived by the weight down an incline of 1 in 3.5 being 2/7th of its weight, it can be seen that one animal can be made to do the work of two, with the further advantage that the animal need not be of the draught quality.

(2) The pulling effort of the animal is saved and that would mean a good deal for the ryot who can make use of that energy for other purposes. An old animal or a milch cow can be made use of for lifting water without a bad effect on its condition.

(3) The mode of using the animal for generating the power is admirable. The animal has neither the pressure of the yoke to feel nor the wasteful troublesome process of moving backwards on the hitch at every operation.

In the trials conducted at the Hebbal Farm the following particulars were noted on a well 16′ deep :—

Capacity of the bucket ..	..	.. 25 gallons.
Gradient of the ramp ..	..	.. 1 in 3.5
Dimension of the trolley	..	.. 4′ x 2′6″

Using an old animal not useful for any work on the farm—

Weight of the animal	900 lbs.
Time tested	½ hour
Number of buckets lifted in the period ..	45
Rate of discharge per hour 2 x 45 x 25 ..	2,250 gallons.

Using a young animal—

Weight of the animal	825 lbs.
Time tested	½ hour
Number of buckets lifted during the period ..	55
Rate of discharge per hour 2 x 55 x 25 ..	2,750 gallons.

During the trial, the following observations were made :—

(1) The upward motion of the free trolley was quicker than the downward travel of the same loaded.

(2) The time taken for filling the bucket was the most, being as much as 12 seconds.

(3) The old animal took more time to mount up the trolley, the difference being as much as 6 seconds which accounts mostly for the increased rate of discharge in the other case.

(4) The old animal being slightly heavier the time taken for the downward travel was less than the other by 2 seconds.

The above observations indicate that with an active young animal of proper weight the capacity can be increased further.

The machine is simple, efficient and capable of being managed and repaired by the local artisan. The principal part of the work is the training of the animal to mount up and get down at the proper moments and this was found, at the Farm to be perfected in a week, the bullockman having within that time acquired the confidence necessary to work the Lift. [G. S. K. & M. G. S.]

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Tilly Alcartra—one of the most Wonderful Cows in the World.

One of the most wonderful cows in the world, Tilly Alcartra, has recently become a victim to the campaign against Foot and Mouth disease in the United States. A pure bred Holstein—Fresian cow, born in October 1908, Tilly Alcartra has a wonderful milking record. She had her first calf on April 9th, 1911, being then 2½ years old. In her first eight lactations, each of which averaged 340 days, which occupied a total time of 9 years and 9 months including

the time she was dry, she produced 2,01,137.9 lbs. milk and 7,816 lbs. butter. This constitutes a world record.

A little consideration of these figures in detail may perhaps make the magnitude of this performance more easily understood. In a total period of 9 years and 9 months this cow milked for what amounts to 7 years and 5 months, and was dry only 2 years and 4 months altogether during the period. In other words for every 9 months and 20 days that she gave milk, which was the average length of her lactation, Tilly Alcartra was dry for 2½ months. Her average milk production during these 9 years and 9 months including dry periods was 56½ lbs. or 19 seers per day. For the period in which she was actually milking her average daily production was 73½ lbs. or approximately 25 seers. As an average over one year this would be a creditable enough performance, but this average is extended over a period of nearly ten years.

The average Mysore cow, including her dry periods, has a daily production of about 3 lbs. or one seer of milk. In the same period of 9 years and 9 months, such a cow would produce about 10,665 lbs. milk, or approximately one-twentieth as much as Tilly Alcartra. But to keep and milk twenty Mysore cows, would require at least fifteen times as much food, and twenty times as much labour as was required in this cow's case.

It is bulls of the same breed as Tilly Alcartra, and from the world's best cows that are being used at the Rayanakere Dairy Farm, for crossing with local and Sind cows. It seems reasonable to believe that with a little patience and proper management, a fairly high producing offspring will result. [W. D.]

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The House-fly and how to Suppress it.

(*U. S. Department of Agriculture, Farm Bulletin.*—1408—1924.)

"The presence of this is an indication of uncleanliness, insanitary conditions, and improper disposal of substances in which they breed. They are not only annoying; they are actually dangerous to health because they may carry disease germs to exposed foods. It is therefore important to know where and how they breed and to apply such knowledge in combating them."

The extract quoted above represents the idea of the author in

brief. After giving a brief description of the other flies which more or less resemble the house-fly, the author proceeds to point out that the true house-fly which is found in nearly all parts of the world is a medium-sized fly with 4 black stripes on the back and a sharp elbow in one of the veins of the wings. It cannot bite and its mouth parts are developed for sucking up liquid substances. The eggs are generally laid upon horse manure but it can also lay eggs and breed in human excrement, hog manure, chicken dung, and decaying vegetable and animal materials as slops, moist bran, ensilage, etc. The house-fly begins laying eggs in 2½ to 20 days after emergence, the time taken depending upon temperature, humidity, character and abundance of food. The number of eggs laid by an individual fly ranges from 120—159. In Panama one fly was found to lay 2,367 eggs in 21 batches with intervals of 36 hours or more. The eggs are deposited below the surface in cracks and several flies lay eggs together. The eggs hatch in 8 to 24 hours and the larval stage is completed in 3 days but may go up to 7 days. The pupae are found at times some distance away from the heaps of manure and under the edges of stones, boards, etc. Pupal stage may be completed in 3 to 6 days in summer but in winter or unfavourable conditions, it may go on for 4 to 5 months. In midsummer a life-cycle can be completed in 14 days. Flies usually remain near their breeding places if plenty of food is available but it has been experimentally proved at Dallas. Tex. that they can go as far as 13 miles.

The body of the house-fly is covered thickly with hairs and bristles of varying length which are responsible for the carrying of germs of disease, and subsequent contamination of human food. Moreover bacteria are found in greater numbers and live longer in its alimentary canal. These germs are voided not only in the excreta but also through droplets of regurgitated matter from the mouth. Thus flies are responsible for typhoid, cholera, dysentery, enteritis and infantile diarrhœa, tuberculosis, anthrax, opthalmia, small pox, etc.

The principal effort to control this insect must be directed towards its breeding place. Absolute cleanliness and destruction of everything on which the flies may breed is essential. There still remains the protection of food materials from fly contamination and fly papers, poisons, fly traps and screens are all useful. With regard to the last all windows and boxes where provisions are stored must

be enclosed with wire having a mesh of 14 strands to the inch. A convenient way of preparing a fly poison is to add 3 teaspoonfuls of formalin to a glass of milk having some brown sugar in it and inverting it over a saucer containing some blotting paper. The formalin-milk keeps the blotting paper wet and all the flies are destroyed. Fly traps can also be made at a very cheap cost. If manure cannot be constantly removed, it is recommended that powdered Hellebore * at the rate of ½ lb. to 10 gallons of water be sprinkled on each cubic foot of manure. A success of 88—99% has been reported with this treatment. In case of decaying organic heaps borax at the rate of 1 lb. to 16 cubic feet of decaying matter has given 90% efficacy. This cannot be very well applied to manure heaps on account of the possibility of the poisoning action of borax in the soil. Even here the soil can tolerate the amount of borax which gets in with the manure when the quantity of the latter applied to the soil is not more than 15 tons to the acre. A mixing of ½ lb. calcium cyanamide and ½ lb. acid phosphate to each bushel of manure (bushel=1¼ cubic feet roughly) has given 98% larvicidal action and has also given two essential ingredients for the soil, *viz.*, nitrogen and phosphorus.

It may be interesting to add that this Department has been recommending the use of a mixture of resin and castor oil boiled together till soft and spread on areca sheaths as a very effective fly trap in the Malnad. During the coming season efforts will be made to obtain accurate data on this and increasing its efficiency by mixing with it other ingredients as brown sugar, ripe plantain pulp, etc. [M. K. V.]

* * * * *

Coffee Experimental Farm.

The establishment of an experimental station in Mysore to study the many problems connected with the coffee industry of the State, has been in contemplation for a number of years. Want of sufficient finances has been the chief reason for the long delay in establishing the same. More than one meeting has been held by the planters to decide upon a special coffee cess to supplement the Government grant and thus find funds necessary for the establishment and running of the station, Colonel Crawford has generously consented to lease out 15 acres

* Hellebore—*Veratrum viride* or *V. Aloum*. Herbaceous plants belonging to the natural order Liliaceae. They are natives of the temperate zone and possess poisonous properties containing the alkaloid veratrine.

of well established coffee for a period of 25 years and at a nominal rental. With Government jungle quite close by, it will not be difficult to expand the station in due course. At a meeting recently held at Chikmagalur under the presidency of the Deputy Commissioner, the planters seem to have unanimously agreed to pay a cess of 2 annas per acre, and hence there seems to be every chance of the station being established in the near future.

* * * * *

Present-Day Problems in Crop Production.

This is the title of the presidential address delivered by Sir E. J. Russell, F.R.S., Director of Rothamsted Station, before the Agricultural Section of the British Association at its recent meeting in Toronto. The main points of the address have thus been ably summarized in an editorial in "Chemistry and Industry" for September 5, 1924.

"Agricultural science has long passed the stage when it was regarded as a branch of chemistry, and it now calls for the aid of the botanist, the zoologist, the plant-breeder, the micro-biologist, as well as of the physicist and chemist. Our knowledge of agricultural processes is very different from that prevailing when Leibig taught that plants obtained all their nitrogen from ammonia derived from the decay of previous generations of plants or brought down from the atmosphere in rain. We now know that the plant organism is plastic and can, within limits, be modified to fit its environment, and soil chemists are well aware that not only is the soil inconstant with its fluctuating population of microscopic organisms but that the relations between soil and plant are not fixed and depend on the factor of climate. Modern agricultural investigation is thus seen to be the study of three variables, plant, soil and climate, factors which, when balanced, result in successful crops. Faced with such unstable materials as the colloid system in the soil, and the vagaries of living organisms, all liable to change at the attack of wind, sun or rain, the investigator has no easy task before him, and it is no wonder that scientific methods of attack have to be combined with the empirical methods of field observations and experiments. It is, indeed, amazing that so much has been achieved by such a small but devoted band of workers. The problems of soil production have now become so complex, however, that the solitary worker can do but little, and the co-operation of workers in all the sciences that bear on agriculture is needed. Sir John Russell concludes his address by a vision of the achievement that would be possible were co-operation effected between the various research institutions in different parts of the world. The value of team-work cannot be better illustrated than by the results obtained

at Rothamsted, and not only in agriculture is it needed—chemistry, medicine, public health, even physics all present their problems that await the onslaught of the well-equipped and eager team. Looking back at the progress made in agriculture, the arid places made to bloom, the crops that now yield many-fold, the immensity of the problems still awaiting solution becomes an incentive to attack, a promise of success. Let us not forget that the founders of Rothamsted were chemists."

* * * * *

Agricultural Education.

We invite the attention of our members and readers to Mr. Gundappa S. Kurpad's article on Agricultural Education. More than one article and editorial on the same subject has already appeared in the columns of the Journal but no discussion on the many important points connected with the subject has taken place as yet. As there is some chance of an agricultural faculty being opened at the Mysore University in the near future it seems advisable to discuss the subject before the scheme takes a definite shape.

* * * * *

Our Annual Meeting.

The Seventh Annual Meeting of our Union has been fixed for the 10th November and succeeding days. Owing to bad seasonal conditions last year, many of the experiments planned out could not be carried out to a successful conclusion and so there will be very little to discuss on the results of work done. An interesting programme on topics of general interest has already been fixed up by the Managing Committee and sent to the members and we look forward to a very lively discussion of those subjects by our members and visitors. As usual, the last day of the meeting will be spent on the Hebbal Farm in seeing the experiments in progress there.

SELECTIONS.

I

Rhinoceros Beetle.

Anent the note entitled "Rhinoceros Beetle" (*Oryctes rhinoceros*), on page 183, March 1923 issue of this Journal, the following experiment carried on by me at the Sugarcane Breeding Station, Coimbatore, might be of some interest. This station has a long belt of young coconut trees about eight years old, and damage from Rhinoceros Beetle is considerable. Before June 1922, the beetles used to be extracted from inside the crowns by the usual hooked needle. This was found to be very expensive, costing as much as four annas per day in the shape of labour, the number of beetles caught being between thirty or forty a day and about ten trees had to be replaced on account of death due to beetle attack. In June 1922, the method of sanding the leaf-sheath bases was tried. Bases of leaf-sheaths from the top downwards—about twelve in number—were filled with river sand in every alternate palm, the palms in between being left as controls. Occasionally, the supply of sand had to be replenished as the trees grew. The results are given in the table below :—

Period of collection	Number of Beetles collected	
	From treated palms	From untreated palms
25th—30th June, 1922 ..	8	23
July, whole month ..	53	106
August, whole month ..	73	152
September, whole month ..	112	290
October, 1st—4th ..	15	22

The diminution in beetle attack with sanding is obvious.—*Agricultural Journal of India, Vol. XVIII, Part IV.*

II

Transplanting Large Trees.

Four date palms and a coconut, all mature trees, about twelve years old, were successfully transplanted this last August on the premises to be occupied by the new office of the Wailuku Sugar Company.

All the trees were growing on the area to be occupied by the building, and as they were desirable trees, rather than cut them down, it was decided to remove them bodily and transplant them in a suitable place, which was selected in the vicinity. A trench was dug arround each tree, about four feet deep, leaving a mass of earth and roots approximately eight feet in diameter on each tree. This was cut under toward the centre making it bowl shape, and was wrapped around with chicken wire netting suitably lashed in place in order to keep the earth in a compact body. The bottom roots were cut off by drawing a loop wire cable under each tree at the bottom of the trench. The side toward which the tree was to be moved was dug out to the desired slope, the tree canted over to allow skids to be placed under it, returned to an upright position and hauled out by block and tackle, with the aid of a tractor. Also by this means the trees were taken to the new location (some fifty feet or more away) and placed in the holes prepared for them. The chicken wire was left in place in order to keep the root mass intact and less disturbed, as the new roots can readily seek an outlet through the mesh. As each tree weighed in the neighbourhood of from ten to fifteen tons, considerable care was required in handling them. It took several days to transplant the trees. Apparently it was successfully done, as two months later all are thriving.

Apparently many trees are needlessly sacrificed which could be transplanted to good advantage with but little cost and effort compared to their value. Before cutting down some rare trees, give this a thought.—*Hawaiian Forester & Agriculturist, Vol. XX, No.* 4.—*The Tropical Agriculturist, Vol. LXII, No.* 3, *March* 1924.

III

Lime Cultivation.

The lime tree should be furnished with an abundance of plant food in the form of fertilizing material, either as barn yard manure or commercial fertilizers singly or in combination to maintain heavy bearing. Vigorous tree growth, dark green foliage, and a small amount of fruit having thick rind and very fibrous pulp indicate the presence in the soil of excessive nitrogen. Liberal applications of potash with the nitrogen tend to produce greater fruitfulness, thinness of rind, and less fibre. In general fruit culture it is thought that young trees require phosphoric acid, potash, and nitrogen in the proportions of 6, 8, and 4 per cent respectively, and that fruiting trees require them in the proportions of 8, 12, and 3½ per cent respectively.

Both seedlings and grafted stock should be at least a year old before they are transplanted to their permanent location. The growing demand for the various commercial products of the lime has created considerable interest in lime culture. Salt-pickled limes are made from the selected yellow fruit, and raw lime juice is expressed from clean, sound limes and after being clarified is used principally in the preparation of beverages. Green limes are shipped to market, usually packed in barrels holding about 1,500 fruits each. Concentrated lime juice which is prepared mainly for the purpose of reducing bulk and consequently the freight charges entailed in the shipment of the raw juice, is exported for use in dye works and pure chemical preparations. Citrate of lime or calcium citrate is replacing concentrated lime juice as a commercial product. When properly prepared it can be shipped anywhere in paper-lined barrels and will keep indefinitely in storage. Citric acid is obtained from the citrate of lime by adding dilute sulphuric acid, which removes the lime and leaves the citric acid in solution. Citric acid has many uses. A very volatile essential oil of high flavour is obtained from the rind of the lime. Lime oil is in demand for flavouring extracts and for perfumery.—*Tropical Life, Vol. XX, No. 4, April* 1924.

IV

Distance in Planting Cotton.

Some results of tests in thick spacing of cotton as opposed to the system of wide spacing, carried out in a number of State experiment stations in America, are said to have demonstrated the value of the thick spacing or single culture system, advocated by the United States Department for several years past. The single culture system spoken of refers, no doubt, to the single plant system all along recommended by the Imperial Department of Agriculture, and more or less generally adopted by cotton-growers in the West Indies. But the tests here reported on would appear to refer to trials in which closer spacing was employed than that practised in these colonies, and which it is claimed give bigger crop returns.

For instance, it appears from results published in the *Southern Planter* for February 15, 1921, that experiments made by the Department of Agriculture some time ago, showed that cotton plants grown 3 inches apart in the row, produced a great deal more than that when planted three feet apart, and that the same is true of all intermediate stages. In other words, the widest spacing is the worst system, and any narrowing of the spacing down to 3 inches is an improvement. These

results are said to have been confirmed recently by experiments carried on at several State stations. The following are the results of a series of experiments reported from the Delta Experiment Station, Stineville, Missisippi, and published in the Journal above referred to :—

	Pounds lint per plot
Plants 8 inches apart	117
Plants 12 „ „	93
Plants 16 „ „	90
Plants 20 „ „	59
Plants 24 „ „	57
Plants 28 „ „	56

Unthinned or left as placed by the planter, average of 2 plots–131½. When two plants were left together, at these same distances between the hills, the results were as follows :—

	Pounds lint per plot
2 Plants in the hills, 8 inches apart	112
2 Plants in the hills, 12 „ „	109
2 Plants in the hills, 16 „ „	99
2 Plants in the hills, 20 „ „	92
2 Plants in the hills, 24 „ „	86
2 Plants in the hills, 28 „ „	71

It is explained that if cotton is grown sufficiently thick in the row, the plants put out only fruiting branches : there is no room for the vegetative branches to grow. Therefore, more plant growth is restricted, and the vitality of the plant goes largely into lint production, with the result that the bolls are put out and mature much earlier and more profusely than when the plants are far apart. When close spacing is adopted however, as in the experiments under notice, thinning must be delayed until comparatively late in the season.—*The Agricultural News.*

V

The Teaching of Agriculture.

We extract the following paragraphs from an address on the subject by Sir A. Daniel Hall, K.C.B., LL.D., F.R.S., Chief Scientific Adviser and Director-General of the Intelligence Department of the Ministry of Agriculture, and published in the *Journal of Ministry of Agriculture, Vol. XXX, No.* 9.

" Now agriculture is a subject *sui generis*, something quite distinct from an applied science ; it has its own technique and methods and its own fundamental science, which is neither chemistry, botany nor

zoology nor anything of the kind popularly termed science. It is accountancy which lies at the basis of the teaching of agriculture, and as pure chemistry is the grammar of the agricultural chemist and botany of the agricultural botanist so is accountancy the grammar fundamental in the instruction of the farmer.

The Object of our Teaching.—If we start off with that somewhat one-sided statement we shall get a little nearer to what is the right form of teaching. Let us begin by asking ourselves what we are after we are dealing with the young men in an Agricultural College. What is our object ? What are we going to try and turn out ? I think it is agreed that we are not thinking of turning out teachers, officials or that kind of men ; we are thinking of turning out a thoroughly equipped farmer and we want to ask ourselves what we mean by that—a thoroughly equipped farmer under modern conditions, and how we can help to ensure that type of man by education. We know well the old farmer who has education behind him ; he tells he has no opinion whatever of book farmers. The answer is not easy, but I think we can remove that kind of reproach if we take our teaching of agriculture from somewhat different angle. What he means is that success in farming depends upon a number of qualities which are personal and many of which are only obtained by experience. If a man has no will or determination, if he lacks a certain firmness about making a bargain, of course he cannot become a successful farmer—and none of the efforts of the educator are directed towards giving these qualities.

Still, putting aside these inborn faculties and the essential matter of experience, what does characterize a good farmer as distinct from a bad farmer ? We can sum it up in one word, management. The good farmer not only knows what work has to be done, what good work is, the technique of growing its crops and breeding cattle, etc., but he knows how most effectively to dispose of the staff of labour that he has on that particular land. His job as farmer is a manager. The Agricultural College is dealing mainly with men who are going to be managers of labour, directors of other peoples' work. They are not going to do manual work themselves, except perhaps in their young days, but in the main they are going to be heads and not hands.

Developing the idea of Management.—When you turn to compare the successful with the unsuccessful farmer you will probably find in a great many cases that the question of financial success depends upon this disposal of labour more than anything else. We may sum up the object of the Agricultural College as the training of managers. That being the case what I want to submit to you is that we must direct our teaching to that end.

Suppose we turn to one of the most successful text-books on agriculture that we have in England, the late Professor Fream's, almost the only widely distributed text-book that has been written in English on agriculture—do you find that point of view, management, set out from the beginning of the book to the end? There may be an odd chapter or two about it, but in the main the book is concerned with the description of the materials of the farmer. You are told how to discriminate between fescues and poas, hop trefoil and yellow clover—just the kind of things that are so much taught and learned by the agricultural student and so heartily despised by the old type of farmer. The old farmer is wrong; you cannot know too much of anything. None of these descriptive points are without their value, only they cannot replace the other things, the vital study of the economics of a farm and its management. That is the point that I want to bring forward in these remarks."

VI

Kikuyu (Pennisetum Clandestinum) : A New Pasture Grass for India.

"Have you got Kikuyu?" every one asked me as I travelled through South Africa in quest of new plants and agricultural instruction. The botanists told me it had been brought to the Union from British East Africa only ten years ago; that it was a nutritious perennial running grass of extraordinary vigour, with rhizomes thick as a lead pencil and abundance of broad tender blades. Most remarkable of all was the fact that Kikuyu was not known to have produced seeds. The agriculturists said that it was a splendid permanent pasture grass on good land; that it required an occasional top dressing of manure and like all other grasses which throw out abundant root stocks. Kikuyu was liable to become sod-bound, and must therefore be cut up by the plough once in two or three years. Where Kikuyu was established, no other grass could exist in the field. It was drought-resistant in a remarkable degree; all kinds of stock liked the grass. The horticulturists were no less generous in their praise of Kikuyu than the botanists and agriculturists. Kikuyu was the perfect lawn grass, not for the tennis-court, the hockey, the football or the polo fields, but for breadths of bright green, dense, soft mown grass. On an established Kikuyu lawn, the feet were said to sink in the delicious sward: Kikuyu was a grass to roll on. In the Cape Province, in the Orange Free State, in the Transvaal, in Natal and Zululand I saw Kikuyu at many farms and around public buildings well worthy of the eulogy I had heard bestowed upon it; but it was at Pretoria in the delightful grounds of the Union Buildings that I first looked on really extensive breadths of Kikuyu. Over all the beautiful lawns there

appeared to be no weed or grass of any description in the emerald green Kikuyu. It was almost with a twinge of jealousy I saw the loveliest lawns of England rivalled here in South Africa.

On the return voyage to India I carried with me a turf of Kikuyu. Apparently more dead than alive, it was planted in a rich bed at the Peshawar Agricultural Station on 3rd September, 1921. Before the first touch of frost in December, the grass had made extraordinary good growth and covered four square yards of land. A slight protection of branches was then given, and the grass came through the cold months of January and February without suffering more than a check in its growth. In April the runners, rooted and unrooted, were divided into six-inch lengths and planted three feet apart each way on half an acre. In four months' time the area was closely covered by Kikuyu, and sheep and cattle were put to graze on it.

In December the more vigorous, soft runners were injured when the mercury fell to 28° F.; the grass was browned and growth ceased, but Kikuyu was otherwise uninjured. With the first warm breath of spring the grass sprang into vigorous growth again.

Two-thirds of the area has been regularly grazed by the farm stock, the remainder has been allowed to grow that the habit and the nature of Kikuyu might be studied.

From the comparative table of chemical analyses quoted below from the *Union of South Africa Department of Agriculture Leaflet No.* 45, it will be seen that Kikuyu compares very favourably with lucerne and other more well-known grasses in this country:—

	Moisture	Crude protein	Carbohydrates	Fat (ether extract)	Crude fibre	Ash	Containing true protein	Nitrogen	Albuminoid nitrogen
Kikuyu (Air-dried)	8·29	12·36	35·06	1·79	33·08	9·42	8·31	19·770	1·330
Kikuyu (Green) ..	76·09	3·63	9·26	0·51	7·91	2·60	2·22	0·579	0·356
Lucerne (Hay) ..	8·00	15·50	30·60	2·40	34·80	8·90	..	..	..
Teff (Hay) ..	8·20	6·00	43·20	1·10	34·80	6·70	..	..	..
Rhodes-grass ..	9·00	9·20	29·30	1·40	42·50	8·70	..	..	..
Guinea-grass ..	8·02	9·03	28·63	1·68	40·54	12·10	7·09	1·445	1·134

Kikuyu is worthy of a trial in any part of India where the average annual rainfall exceeds 20 inches, or irrigation is available. As it does not produce seeds there is little danger of the grass spreading to fields whereon it might be undesirable. Kikuyu may go a long way in helping to provide really good nutritious grazing for the dairy cattle in India, for wide sweeps of lawn or for the race course. It is probable that it will prove superior to *dhub* (Cynodon dactylon).—*The Agricultural Journal of India, Vol. XIX, Part* 1.

VII

Agricultural Education in India.

[In view of the suggestion that a College of Agriculture should be started in connection with the Mysore University, the following paper on Agricultural Education by Dr. K. Kunhi Kannan, M.A., Ph.D., F.E.S., Entomologist to the Government of Mysore, which was read before the annual meeting of the Madras Agricultural Students' Union in 1923, is reproduced here. The views expressed there are not necessarily the views of the Department as a whole or of other members of the staff but will form a useful basis for the discussion of the proposal. We feel the Members of the Mysore Agricultural and Experimental Union will have valuable suggestions to make in this connection and we cordially invite discussion.—Editor.]

The importance of agricultural education as a method of facilitating the diffusion of scientific ideas and practices in regard to agriculture has been sufficiently recognized to render the discussion of the subject welcome to all who are interested in the agricultural progress of the country. It was not until after half a century of Indian Education that thought was bestowed on its serious defects and solutions were attempted. It reflects, therefore, no small credit on those interested in agricultural education that, so early in the history of it, they have set about finding the correct lines of advance. These efforts are no doubt part of the general reaction from the tendencies of Indian Education in general, but are for that very reason more sustained and energetic.

We have now progressed in our ideas in regard to Indian Education in general so far as to believe that Western systems have their value only to the extent they fit in with the conditions of the country. The primary aim of all education is the adjustment of the community of its needs and requirements by an appropriate and balanced development of its capacities. No education can be said to be satisfactory which makes for dislocation, and nowhere is this more true than in agricultural education. I am afraid we have not recognized sufficiently the conditions which agricultural education has to meet in this country. We have failed to take note of the fact that agricultural education was

started and developed in Western countries under the influence of capitalistic farming induced by high prices. In most of these countries, industrial progress has been, in speed, direction and volume, much greater than agricultural progress. In the countries of the New World and European colonies elsewhere, the abundance of virgin land has made for capitalistic farming and all that it implies of the application of science to agriculture. These facts had, and still have, important consequences. Industrial progress makes for the accumulation of capital and capital seeks investment. Where the investment is on land, the holdings have to be of large size, and the aid of science has to be sought for adequate return. The men that take to capitalistic farming have to be thoroughly trained in the science of agriculture, to make it a financial success. They are not usually, men brought up in rural areas and are, therefore, not familiar with agricultural practices and conditions. This is even more true of the countries of the New World and the colonies, where the men who seek an agricultural career are absolutely new to the profession and, therefore, have to seek education in that subject in a school or college. The systems of higher agricultural education have been developed and perfected in the West to meet the needs of these men.

None of these conditions exist in India. We have to do here with an enormous population, deriving for the most part, its subsistence from land, which is rapidly proving inadequate to meet the needs. An average size of four acres for a holding does not hold out much prospect of capitalistic farming. Our industries have not been sufficiently developed, nor are they going to develop soon enough for the accumulation of capital and for capital to seek investment in land. The mutual interaction between industry and agriculture, which is so beneficial to both and therefore to the community, resulting in a general rise in the standard of living, of efficiency, intelligence and enterprise, will take many a long year to come. Whereas, in the West, urban standards tend to raise rural standards, in India, rural standards tend to depress urban standards ; not even if we suppose, for a moment, that capitalistic farming will spread in India, is such a prospect to be welcomed, except in special tracts and in the case of special crops. We cannot face with equanimity the prospect of a landless proletariat in an over-crowded country with hardly any out-let for her surplus population. Their presence has been a serious danger even in countries, far less crowded, of the West with limitless opportunities they had in their foreign possessions. Nor again, under the laws of inheritance prevailing in India, have large properties, brought up to the requirements of capitalistic farming, any chance of resisting the forces of division and disintegration.

These are obstacles to capitalistic farming in India, which will long remain insuperable, and yet until recently effort was directed towards the education of men for capitalistic farming. The graduates of the Agricultural Colleges in India, drawn perhaps from classes with agricultural incomes, have failed to develop agricultural leanings. The migration city-ward is a distressing phenomenon, even in the West, where conditions of small townships and villages approximate fairly closely to those of larger centres of population. Yet in India, where these conditions diverge so widely, that very few of the services—medical, sanitary and educational,—to which English educated men are accustomed, are available in the village, we have not yet ceased to expect agricultural graduates to settle down to farming in villages remote from these services and with little opportunity for developing the intellectual and social interests they have acquired.

The experience of the past two decades of agricultural graduates, seeking in increasing numbers to preach scientific agriculture through the departments instead of practising it on their own farms, has convinced us that this type of agricultural education does not meet the actual situation in the country. We are now experimenting with middle schools, and several types are under trial. Even here, we have not grasped fully some of the essential features of the agricultural population, for whose benefit the education is intended. We have not made sufficient allowance, in our schemes and syllabuses, for accumulation of experience through forty centuries of agriculture, the essentially rural atmosphere from which students are, or have to be, drawn, the apprenticeship they have had under their fathers and their inherited aptitude for farming. The ryots and their children know the value of good seeds, good manures, of good cultivation, of the conservation of moisture and of rotation. What they do not know are the resources which the latest developments in science place at their disposal. They do not know the value of the improved implements of new types, and strains of seeds produced which increase yields and resist diseases, of the methods of combating pests and diseases, and of artificial manures. Where experience is already there which has stood scientific scrutiny—and in regard to many an item of agricultural operation such experience undoubtedly exists - we should not have spent time in traversing the ground over again, except so far as to interpret that experience in the light of science. And last but not least, we have not taken into account the fact that education should be designed, not so much to help individual investigation and judgment, as to create confidence in the work and in the recommendations of the Department. With agricultural departments

in all the provinces rapidly developing in strength, the ryots have, ready for the asking, expert advice in agricultural matters and there is no need to give an elaborate course modelled on those given in Western countries, where men and land are alike new to agriculture.

These considerations point, to my mind, to the wisdom of confining agricultural education to those aspects of which the ryots are now ignorant and to those other subjects equally necessary to bring ryots into better harmony with their environment. Such a course should be far more practical than theoretical and be covered in about a year. It is best given on a seed farm, where seeds required for the locality are grown for distribution. The farm should be run on business lines and worked at a profit, the profit going towards the expenses of board and lodging of the students. The pay of the manager and of a teaching assistant should alone, as a rule, be met by the Government. The farm should not be hampered by official routine but should bring the ryots and the Department into touch with one another. The students should ordinarily have had middle school education and be between 15 and 20 and capable of doing all the work on the farm. The afternoons should be devoted to simple lessons in the various subjects, or to inspection of crops in the locality grown under ordinary conditions. It is not necessary to go into greater details to enable you to form an idea of the course I have in mind, but there are some subjects which deserve mention. Among them are rural sanitation and hygiene, co-operation in credit, marketing and purchase, conservation of forests, methods of land survey, assessment and rules regarding revenue collection. No elaborate education in these is suggested, but it is expected that students should know these to help them, as much to understand and observe Government rules in regard to these, as to avoid being victimized by petty officials.

In advocating a simple and short course of this description, I am by no means suggesting that higher education should no longer be given. The very highest standard is necessary for those required to man the agricultural departments, but the number of colleges where this higher training is given should be limited to two—one for the north of India and the other for the South. In these two colleges, there should be training in administration as well. For those who fail to qualify for entry into Government services, facilities should be provided which should induce them to settle down to farming.

But the main effort, and much the larger proportion of funds, should be directed to the establishment of one-year courses designed to train up students drawn from among the classes of small farmers, the labouring ryots, from whom comes the bulk of our agricultural production. They

contribute, in proportion to their slender resources, more revenue than other classes. It is their money that goes so largely to the support of every branch of Indian education, and equity as well as policy demands that the major portion of the funds available for the agricultural education should be spent for their benefit, to make them more receptive of the scientific ideas which agricultural departments set in circulation, and not diverted to futile and impractical efforts of encouraging capitalistic farming for which opportunity hardly exists in India. An education on these lines, the best adapted, as I believe, to the needs and requirements of the bulk of our agricultural population, should prove immensely attractive and should help them to resist better the forces against which they are now powerless, and thereby speed up agricultural production to the level of the pressing requirements of the country.

VIII

Papain.

Articles on "Papain, its Production and Uses" and "the Preparation of Commercial Papain" were published by the writer in the *Agricultural Bulletin*, Vol. II, No. 7, February, 1914, pp. 190–192 and Vol. V, Nos. 5 and 6, February–March, 1917, pp. 202–203.

The information contained in the present article embodies that previously published, together with additional information from other sources and replies received from various firms in England, Canada and America which are interested in this product.

Source of Raw Products.—Papain is a proteolytic or digestive enzyme contained in the juice of the fruit and other parts of the Papaya tree (Carica papaya).

The commercial product, which consists of a cream coloured or white powder, is obtained from the fruit of the tree.

Cultivation.—The papaya tree, as is well known, grows extensively in Malaya and other eastern tropical countries and other parts of the tropics, including tropical Australia and is grown largely for its fruit.

There are three kinds of trees:—(*a*) hermaphrodite or perfect flower, (*b*) female or pistillate, (*c*) male or staminate. The trees are propagated from seed, which should be sown in a well-prepared seed bed about $\frac{1}{2}$ inch apart. The seeds should be covered lightly with soil and the seed beds should be watered. The beds should be shaded and, if the seeds are sown during the rain, the beds should be sufficiently protected to prevent the washing away of the seeds.

The seeds germinate in about 2–4 weeks and may be transplanted when about 3 inches high. The plants should be watered before transplanting and three-fourths of the leaf blades should be removed to prevent wilting. The soil should be well pressed round the roots and the seedlings planted at about 10 feet apart. Cover crops may be grown on the land. Water should be supplied, if the plants tend to wilt. The plants, however, will not tolerate a water-logged soil. The trees begin to bear fruit after about one year and the fruit may be tapped to obtain the juice when they are three months old. Only mature, but not ripe, fruits should be tapped.

Cattle manure is applied largely in India in the cultivation of the tree. The following mixed fertilizer has also been found to be very successful in Hawaii—superphosphate 800 lbs., sulphate of potash 315 lbs., nitrate of soda 250 lbs., sulphate of ammonia 190 lbs., volcanic ash 445 lbs. Ploughing and harrowing, during the early stages of growth, are also recommended in India.

If properly looked after, the plants may last for 5 to 10 years, but the period of profitable production is said to be 3–4 years. Special fruits, varying in size and shape, can be produced by adopting suitable breeding methods.

Composition of Fruit.—Analysis of the fruit has given the following results :—

	Per cent
Water	90.75
Protein	0.80
Oil or fat	0.10
Nitrogen free extract	6.32
Fibre	1.09
Ash	0.94

The most important constituent is the digestive or proteolytic enzyme—papain.

Preparation of Crude Papain.—The juice which contains the papain, is obtained by making shallow longitudinal incisions, about $\frac{1}{8}$ inch deep, in the unripe but well-grown fruits, by means of a non-metallic knife (a bone or ebonite knife). Rustless steel knives will be satisfactory if it is found that they do not discolour the juice.

Fruits, in which only three to four incisions are made simultaneously, can be incised again after a day or two but if seven to eight incisions are made, subsequent tapping is said to yield very little juice or latex. The juice resembles a white thin sticky latex, which coagulates rapidly.

The fruits should be incised in the early morning and the juice strained through muslin and dried at about 35° C. for two days, when it forms a cream coloured brittle mass with an unpleasant odour. The mass can be ground to a powder.

The juice should be collected in glazed earthenware or china cups. A trace of formalin added to the juice prevents decomposition. Small quantities of juice may be dried in the sun on sheets of glass. Large quantities, however, are prepared preferably by spreading the juice on linen trays made by stretching brown linen on wooden frames placed over a hot-air chamber of brick, avoiding excessive heat. This can be done by using an iron plate covered with 2–3 inches of sand between the fire and the hot-air chamber, with the trays about one foot above the plate. Artificial drying in this way should be done below 100° F. (below 40° C.) ; on a large scale vacuum drying and the contents on several trays can be placed subsequently in one to complete the drying. The juice should be dried till it is crisp and capable of being reduced to a powder. A cream coloured or white powder is obtained.

The yield of crude dried material amounts to about 16–18 per cent of the weight of the juice.

The yield per tree will depend on locality and amount of fruit. A tree with thirty fruits may yield 1 lb. of crude papain. A dozen shallow cuts about $\frac{1}{2}$–$\frac{3}{4}$ inch part on a fruit of good size will yield $\frac{1}{2}$ oz. of papain.

One authority gives 0.4 lb. of fresh latex per tree while 40 fruits have yielded the same amount. In Ceylon the yield is from $\frac{1}{2}$ to $\frac{3}{4}$ lb. of papain per tree. In India the trees are planted 400 to 500 per acre and the cost of cultivation, collection and preparation of papain is estimated at 200 to 250 rupees per acre.

Purification and Standardization of Papain.– The commercial product is said to be often adulterated with starches. The "activity" number (*i.e.*, the amount of protein digested in a fixed time at a definite temperature by unit weight of papain) varies considerably.

By Pratt's method (digestibility of casein from milk) commercial samples from Ceylon gave "activity numbers" from 0.5 to 9.7. Mexican samples have given 12.9 and West Indian samples 40.0. Philippine samples, prepared in the laboratory of fresh latex (on dry basis), gave 45.8, undried latex (on dry basis) 45.4, alcohol precipitated papain 72.2 and Indian samples, 44.4 on egg albumin.

(*Note.*–Pratt uses a 40 per cent solution of a sweetened, condensed, skimmed milk as substrate and a 0.5 per cent aqueous solution of papain.)

25 ccs. of milk, with 23 ccs. of water and 2 ccs. of a filtered papain solution containing 5 m. grams of papain per cc. mixed and at the end

of the digestion period (30 minutes at 40° C.) the undigested casein is precipitated by adding 0.5 ccs. of copper sulphate solution (6 per cent) followed by 0.5 ccs. of glacial acetic with vigorous stirring during the precipitation. The precipitated case in is broken up, washed on an oven and weighed. A blank experiment is used as a control. This method has been adopted by subsequent experimenters in the Philippines, on account of its reliability and simplicity.

Brill and Brown of the Philippine Bureau of Science (The Philippine Journal of Science, Vol. 20, No. 2, February 1922, p. 185) state that papain appears to lose its activity on keeping ; a sample examined by Pratt in 1914 which digested 85 per cent of the casein in milk in 30 minutes, has lost all its activity in 1921, although the dried material had been sealed up in small glass vials and protected from sunlight.

These experimenters found that alcohol-precipitated papain is more active than sun-dried papain. By dialysis of the milk (a 10 per cent solution of a dried powder was used, instead of the sweetened condensed skimmed milk employed by Pratt) to remove mineral salts, greater activity was shown.

These experiments conclude that autolysis of papain takes place at temperatures as low as 0° C. when the enzyme is put in water with toluence as in antiseptic. Sodium chloride shows first a slightly activating effect followed by an inhibiting effect in more concentrated solutions ; sodium carbonate and bicarbonate and calcium chloride, magnesium sulphate and boric acid have no marked effect ; potassium chloride and sodium citrate showed marked activation while acetic and lactic acids showed strong inhibiting effects.

The following method of purification has been applied in India : 20 grammes of fresh latex are stirred with 100 ccs. of 95 per cent alcohol producing a white gummy coagulum. The alcohol is poured off and a further 50 ccs. of alcohol added to the coagulum, which crumbles to a fine powder. The powder is filtered and washed with ether to remove a semi-solid yellow wax and to facilitate drying. The washed papain is dried in vacuo and gives a pure white powder, amounting to 3 grammes, equivalent to 15 per cent, on the fresh latex. The papain solution (0.10 papain) is added. The mixture is digested for 15 minutes at 80° C. The following results were obtained on different samples of papain :—

(*a*) Juice dried at 35° C. (Neutral). Protein digested 55.9 per cent.

(*b*) Dried juice extracted 10 times with water for 6 hours and filtered ; extract precipitated with 2 volumes of 91 per cent alcohol and dried in desiccator (Neutral). Protein digested 51.0%.

(*c*) Fresh latex precipitated with 2½ volumes of 91 per cent alcohol and dried in desiccator (Neutral). Protein digested 56.8%.

(*d*) Latex treated as in (*c*) and then washed with ether after drying for one day and then dried in desiccator (Neutral). Protein digested 67.1 per cent.

(*e*) Fresh latex precipitated with 5 volumes of 94 per cent alcohol and washed three times with either, and dried in desiccator (Neutral). Protein digested 2.8 per cent.

(*f*) As per (*e*) but solution acid. Protein digested 2.8 per cent.

(*g*) As per (*e*) but solution acid. Protein digested 2.8 per cent.

These results indicate that the papain prepared from the juice by precipitation with alcohol and subsequent washing with ether gives the most active product.

It will probably however be preferable to leave the purification to the manufacturers who purchase the raw product and to prepare a good dried juice on the estate.

The following parts in the preparation should be noted:—

(1) The juice should be dried as soon as possible.

(2) The drying should be effected below 40° C., otherwise the activity of the papain will be reduced or destroyed.

(3) Final drying is effected preferably in a vacuum drier.

(4) The product should be ground to powder and packed at once in air-tight stoppered bottles or lead-lined wooden boxes.

Further experiments indicated a remarkable activity when the digestion of the protein (Egg albumin) was carried out at temperatures as high as 90 to 95° C. in acid or neutral solutions, which seems remarkable.

(*Note.*—Details of the above experiments are contained in "The Philippine Journal of Science, Vol. 20. No. 2, February, 1922, p. 185" and "The Agricultural Journal of India, Vol. XVI, No. 5, September, 1921".)

Markets and Value.—The following information has been received in reply to a questionnaire addressed to various firms in England, Canada and America:—

Firm A. (New York, U. S. A.)—Imports into United States of America for year ending June 30th 1914. Papain extract—39,419 lbs., valued at $74,866 gold. From Germany 94 per cent, from England 6 per cent. Papain "Select"—6,181 lbs., valued at $26,613 gold.

Germany—89 per cent, Holland—8 per cent, British West Indies—3 per cent.

The product described as "Select" is properly a dry crude papain.

The crude papain, which is now imported, is packed in bags and fetches $1.50 to $1.75 per lb. C. I. F. New York (December 1922).—It is usually sold on test. The amount imported at present is probably about 50,000 lbs. per annum.

Firm B. (England)—No information of any value.

Firm C. (Canada)—The dried juice should be packed in a tin, glass or jar container and sealed. The product should be bone-dry.

This firm imports juice from its own estates, packed in ordinary kerosene or gasoline tins.

Firm D. (England)—This firm quotes prices from four different wholesale lists as follows :—(A) 3/2 per oz. (B) 2/6 per oz. (C) 3/2 per oz. Merck's 22/2 per lb.

Firm E. (England)—No information of any value, except as to packing in air-tight containers. This firm states that there is a very restricted market in London, as papain seems to have largely gone out of use in medicinal preparations.

Firm F. (England)—Market price (Sept. 1922) 7/3 per lb. The product should be packed in lead-lined cases, containing about 56 lbs. There is a fairly good demand for the product, which is sold on test. It should be free from sugar and starch.

Probably between 250 and 500 lbs. per month could be taken.

Firm G. (England)—Branch of New York Firm A.—Market in London very limited and consignments sent to England appear to have been chiefly exported again. The United States of America, the chief consuming country.

The above replies appear to indicate that the chief consuming country is America.

The present price of this product is 3/2 per oz. in London and $2/15 to $ 2/25 gold per lb. in 10 lb. bottle (U. S. Pharmacopœia) Powder or $1/85 to $ 1/90 per lb. Crude, in 150 lb. cases.

Conclusions.—The cultivation of the Papaya tree for the production of papain should be an economic proposition on a small scale. The plants could be grown with other crops ; coffee, or Kapok could be grown if the papaya trees are planted widely.— *The Malayan Agricultural Journal, Vol. XII, No. 5, May,* 1924.

IX

The Problem of Agricultural Labour in India.

By Radhakamal Mukerjee, M.A., P.R.S., Ph.D.

The Lower Orders.

The economic distribution of wealth is to be judged from the broad division of population into agricultural, industrial, economical, professional and other classes. A closer examination would require, in the first place, the differentiation of industrial workers from agricultural labourers (farm hands, etc.) and general low-grade labourers of the miscellaneous and casual type who are on the margin of work and life, and secondly, the isolation of the fixed wage-earners from the rest. It is on the landless classes and the receivers of fixed incomes that the vicissitudes of the times deal their hardest blows.

The professions representing more or less the affluent sections of the community form a microscope minority. The fixed wage-earners also form a very small section. The unskilled labourers are now seen to increase decade after decade. The following table shows their number in 1911 and 1921 :—

	1911	1921	Variation per cent
Farm servants and field labourers.	41,246,335	37,924,917	8.1
Labourers and workmen unspecified	8,273,650	9,300,105	12·4

Hired labourers in India, unlike those on the farms of north and north-west Europe, are not whole-time professional labourers but part-time day labourers. They usually own a little land themselves, and would like more but there is also a growing class of landless labourers whose employment is uncertain.

Every circumstance which has weakened the economic position of the small holder, has increased the supply of agricultural labourers, the loss of common rights in the rural economy, the disuse of collective enterprise, the sub-division of holdings, free mortgaging and transfer of land and the decline of cottage industries. The growth of population in this century has been so great and the holdings have so much been reduced in size that they have often become uneconomical, compelling the peasants to supplement the proceeds of their holdings by outside work, or to sell their lands to middlemen or to more prosperous peasants. It is noteworthy that the populations on the margin of life engaged in occupations that entail heavy physical but little mental energy are endowed with larger families than the higher and the more intellectual

sections of society. In a normal decade with no epidemics or other disturbing factors, such sections of the community may be expected to increase faster than the rest. The last two decades have been unusual, and the mortality which is always the heaviest from these lower orders has been particularly heavy. Mr. S. V. Mukerjee who in his Baroda Census Report discusses this question shows that the number of agricultural labourers has been progressively decreasing since 1901; but on the other hand, the number of cultivators and receivers of rent from agricultural land (with their dependents) has progressively increased (from 970,675 in 1911 to 1,058,182 in 1921). The Punjab Census Report similarly records an increase of the number of persons living on income from rent of agricultural lands from 626,000 in 1911 to 1,008,000 in 1921. On the other hand, the number of farm servants and field labourers has actually decreased from 1,191,000 in 1911 to 1,134,000 in 1921. In Madras there is a similar tendency throughout the last 20 years for cultivating landowners and labourers to lose ground to the cultivating tenant and the non-cultivating rent-receiver or rent-payer. Does this imply, asks the Census Superintendent, that the man who farms his own land is being forced to relinquish it to the non-cultivating money-lender from whom he will cultivate as a tenant? In the United Provinces, the number of ordinary cultivators has increased from 28,712,015 to 29,843,168. On the other hand, the number of farm servants and field labourers has decreased from 4,552,043 in 1911 to 4,035,887 in 1921, the decrease being 11.3 per cent. In Bengal also the number of ordinary cultivators has increased from 29,748,666 to 30,547,557, and the number of farm servants and field labourers has diminished from 3,660,000 to 1,805,502, the decrease being 50 per cent.

It is doubtful whether this increase in the number of cultivating owners is an unmixed good. Where the agricultural labourer, as a result of the rise in prosperity, sets up as a peasant proprietor, we may hope he turns his land and his own life to good account with the magic of property around him. But he is mostly without staying power and his holding is more often than not too small to be economic. By a selective process the superior cultivator is driving the more thriftless of his brethren to the marginal areas. Thus the extension of cultivation results, if at all, in a gradually diminishing return to an increasing amount of labour and expense. It is noteworthy that the figures of the transfer of land by agriculturists to non-agriculturists show that the tendency of the latter to take possession of the agriculturist's land is to a certain extent increasing synchronously with the tendency to rent the land rather than cultivate through hired labour. In Bengal ordinary cultivators number

9,274,927, workers and the farm servants and field labourers number 1,805,502. There is thus only one hired labourer on the land to every five who cultivate land of their own. In Dacca and Chittagong divisions, there is only one hired labourer to eight ordinary cultivators. In the United Provinces there are 16,092,000 cultivators (workers) while the farmers and field labourers total 4,035,887. Here there is only one hired labourer to every four cultivators (workers). In England and Wales there are by contrast, well over 3 hired labourers to every farmer. It may be said generally that the holdings in the United Provinces, Behar and Bengal are so small that the cultivation of them is hardly ever too much for their owners themselves to accomplish unaided.

The Economical Holding.

And in fact the greater the pressure of the agricultural population on the soil and the more uneconomical in size the holding becomes as a result of minute sub-division, the less will be the tendency to employ hired labourers in the fields, who will have to seek employment in the rural tracts as earth-workers and road-menders or migrate to industrial towns and plantations. At present the conditions of the casual agricultural labourers are miserable and are being rendered worse on account of the competition amongst them. They vary from practical slavery to comparative independence, but such is the custom of the country that the master nearly always contrives to get his servant into his debt, and thus obtains a powerful hold over him in case he thinks of leaving his service. Sometimes these servants are paid a fixed annual quantity of grain, sometimes all they can claim is a specified share of the yield of their master's land : in other regions these methods are combined. Among many of the depressed castes of South and Western India such as the Puleyas, the Holiyas, the Dublas and Kolis, serfdom prevails to a limited extent. Most of these families are serving from several generations practically as bondslaves to their masters. They received money in advance for their marriage and orally bound themselves to serve till they paid off their debt. They are fed and clothed by their masters. The first agreement may be for a term of years but this term usually leads up to another and that to a third, till in the end all hope of redeeming the advance is gone. With the increasing pressure on the small holding the economic conditions discourage the employment of inefficient semi-slave or hired labourer while the rise of prices increases the cost of maintaining it on the land. Thus in many provinces there is an exodus of agricultural labour from the holdings of cultivating landowners. There is no doubt that as in many provinces there is a very

little of culturable land left unoccupied, the best cultivators will not usually care for it and, as each additional area is leased for cultivation, there being less and less demand for agriculturists, more and more of these landless labourers drift in to take it up, others drift to the mines, factories or plantations in the country or go abroad. In some provinces, however, agricultural labour is starving and agriculturists feel bitterly their want for the field labour and apprehend a fall in the value of land in consequence of a demand for the same. This has been felt, *e.g.*, in some parts of Madras and Bombay. In Madras in particular the immigration to Burma, Ceylon or the Straits from the East Coast has long been a source of the depression of agricultural labour. Thus the peasant proprietor in different parts of India is encountering contrasted conditions of the supply and demand of field labour. On account of the sub-division of land and an ever-increasing pressure on his meagre resources, cultivation cannot be efficient and economical in many parts of the country by the employment of the present quota of hired labourers. On the other hand, in other parts, land cannot be efficiently cultivated on account of the scarcity of agricultural labour due to the diversion from the original pursuits by absorption in factories, mines and plantations or by emigration. Thus both in India and Japan we are already witnessing the transition phenomena of a change from the regime of intense devotion of national energies to agriculture to a period in which the people driven by their misfortune from their passionate attachment to the soil, will strive to seek more and more in a varied industrial life, the requisite relief for the pressure of an increasing population on their means of subsistence. In the co-operative movement, however, there is the hope that agriculturists will find the ready capital and organization, which will increase their net profits. Both agricultural co-operation as well as the use of labour-saving appliances of scientific agriculture will be rendered inevitable in India in the coming decades when the employer of general labour will be able to offer to the increasing classes of landless labourers more attractive wages than what the farms can offer.

The Rent-Receiving Class.

If the economy of the small holding be not revolutionized in India, and the cultivators do not break down their many prejudices and false pride which prevent them from turning to many remunerative forms of labour, land will pass more and more to the hands of the non-cultivating, rent-receiving and middleman class while an increasing class of field labourers recruited from an inefficient and impoverished peasantry which works on meagre resources will cease to be supported by agriculture. An agricultural situation similar to this has arisen in Japan, where in

spite of her most remarkable advances in scientific agriculture, the distribution of agricultural interest is fraught with grave social perils. Of the 5,500,000 households engaged in agriculture 31 per cent cultivate their own land only. The remainder nearly 70 per cent are dependent to some extent on rented land. Of this 70 per cent, 30 per cent are pure tenants, owning no land at all. The remaining 40 per cent combine tenantry with the cultivation of some land of their own. The number of owners who possess less than one and a quarter acres is just a little greater than the number of farmers who cultivate their own and some tenanted land. This causes the suspicion that a very large proportion own very little land. The actual farming population is being more and more divorced from ownership in the land it cultivates. Those families which own all the land they work are becoming not only fewer in proportion to the whole, but fewer absolutely. In the last ten years there has been a loss of 100,000. Correspondingly there has been a marked increase in the proportionate and absolute number of those dependent entirely, and those dependent partially, upon rented land. Thus the entire increase in agricultural households is an increase in tenants or partial tenants. And besides this, 100,000 who owned the land they cultivated, have become tenants. Thus the condition of the majority of the farming population, represented by the tenants and smallest owners is miserable.*

The Regulation of Agricultural Labour Conditions.

A relief to the surplus of agricultural labour is found in emigration. And, indeed, annual migrations of agricultural labourers from one district of a province to another have been going on for a long time. Thus in the United Provinces, there is seasonal migration from the Terai to the rice-fields of the plains, in Bengal towards the north-east. There is also the continuous exodus of unskilled labourers to the towns, mines and industrial centres which offer an expanding field of domestic service and industrial employment. Further, there is an overseas emigration of peasants who find market for their labour in the mines, plantations and industries of the lands of their settlement. The Indian emigration overseas has been subjected to a restrictive policy in recent years. In those regions where the number of day-labourers exceeds the demands of industrial employment on an adequate remuneration, the problem of an agricultural proletariat becomes acute. This has been the case to a certain extent of the Punjab, the United Provinces, Behar and Bengal, which therefore resemble the non-industrial countries like Italy,

* Buchanan, The Rural Economy of Japan, in *The Quarterly Journal of Economics*, August 1923.

Spain, Hungary and other parts of Central Europe in which there is a surplus of agricultural labour which cannot find adequate employment. Great Britain and Germany on the other hand have developed an industrialized farming and the amount of labour engaged in it is considerable; while in France, in spite of the pulverization of holdings which has given rise to the great and unsatisfied need for the re-stripping of holdings, the mortality of the war has combined with the rural exodus to make a plenty of available land and a dearth of agricultural labour. The problem in Continental Europe has been already tackled by legislation, but this presents numerous difficulties. Schemes of insurance against agricultural unemployment in Europe do exist, but only in a few countries of Northern Europe, not where they are most needed. Again, the statutory regulation of hours of labour would seem purely to depend on the question whether a capitalized system of agriculture has given rise to a class of land workers who have succeeded in attaining some degree of organization among themselves, as, for instance, in Germany, Spain, Czecho-Slovakia, and North Italy (only in the rice-fields); but such regulation is often wholly lacking just where it seems most required, or yet again, protection by insurance against accident is apparently a benefit enjoyed most securely by those agricultural workers who happen to live in an industrialized country; the advantages of the industrial system have been extended to such agricultural workers, while in a non-industrialized country they may have to go without them. In India the question whether or how hours of agricultural labour might be fixed has now been raised. In Europe, in the northern countries where arable farming is associated with stock-raising and there is distribution of employment over the whole year for a permanent staff, it has been found practicable to limit hours of employment. Such a uniform system is not true of Indian farming, where the hours of labour are unequally distributed between different seasons and where both in the sowing season and during the harvests labourers must work long on account of the nature of their work and the special difficulties of Indian agriculture. Yet there cannot be any doubt that the casual hired labourer is made to work for very long hours under most trying conditions and has no organization like the English Agricultural Labourers' Union and the Agricultural Section of the Workers' Union which have met with striking success in securing better terms for hired labourers.

Land Adjustment in Central and Eastern Europe.

Another device which is common to most European countries for the establishing or improvement of agricultural labour conditions in Europe is land settlement. The end of the big land holdings came

quickly, rudely and without system in Russia. With the outbreak of revolution the peasants simply seized the land, appropriated the neighbouring estates and divided them among landless and landholding peasants according to the will of the Soviet or perhaps in certain cases according to the right of strength. They did not wait for formal methods, for laws and decrees and officials from Moscow. The question of compensation to the owners was not raised. The Central Bolshevik Government at Moscow had the theory that the big estates should be made into communal farms, but the peasants did not fall in with that way of thinking. A limited number of communal farms were put in operation, but their efficiency proved very low and many of them have since ceased to operate. The general upheaval may ultimately result in a thorough-going regrouping of the land holdings such that each peasant will get his land in a single piece. Comparatively little has thus far been done in this direction since the Revolution.* In Germany an owner's property in excess of 247 acres has become liable to confiscation. In Hungary the Act states that he may retain enough land to enable him to farm on a scale consistent with good agriculture. In Bulgaria he may keep only 75 acres of arable land or 125 acres of forest and pasture land. In Roumania five million acres had been expropriated at the end of 1919 and the large farms between 100 to 500 hectares which cannot be exceeded legally cover only 8 per cent of the country's territory and they will be capitalized farms which will be models for the peasants. In Poland a Law providing in principle for the breaking of the big estates was passed in 1919, and about 1½ million hectares are to be parcelled among the small peasants and the landless men. The maximum area of the peasant holding thus formed or enlarged is placed at 34 acres in Poland ; at 21 in Hungary where, however, there are also to be 4 acres labourer's settlements. In Yugo-Slavia the maximun legal area of property varies with districts from 50 to 500 hectares. In Czecho-Slovakia an owner may retain 150 hectares of agricultural land or 250 of land of any sort.† There have thus been sweeping agrarian reforms in Central and Eastern Europe all of which have had the same scope : they have expropriated large landholders and divided up their estates among peasants and landless men.

The maximum area which an individual continues to hold without liability to sequestration, varies. Three principles are recongnized : (1) that the expropriated owners have a right to compensation : (2) that the

* Durand, Agriculture in Eastern Europe, *Quartely Journal of Economics*, 1922, pp. 1903—04.

† *Vide Manchester Guardian Commercial*, August, 1922 and *Irvine*.—The Making of Rural Europe.

new small holders should pay by easy instalments, at least part of the price of the land they acquire and (3) that the new holdings are to be such as can be farmed by the owner and the members of his family. In Scotland, Acts have been passed protecting tenants who hold no more than 50 acres of land and pay a rent of no more than £50 a year and empowering the Board of Agriculture to constitute new small holdings and enlarge those in being, either in agreement with the landlord, or in execution of a compulsory order of the Scottish Law Court. Like the Scottish Reforms and those made in Continental Europe since 1917, Acts have been passed in Ireland which have made many rack-rented farmers into small owners and, together with the active and efficient co-operative societies, into thriving owners. In the almost purely peasant countries like Scandinavia, Denmark, the Low countries and Greece, there is no Green Rising because the land is already almost all held up by prosperous small farmers. There is an actual shortage of agricultural labour in Sweden, while in Denmark cultivation is so highly intensive that it absorbs the available supply of labour. It will take a long time to develop scientific agriculture to that extent in India, while the efficiency of village trade unions and success of collective bargaining which have indirectly contributed to good farming and a high rate of agricultural production cannot be expected in India within a few decades. Rural Syndicalism has permeated the landworkers in Spain and Italy while the success of agricultural co-operation has given rise to schemes which propose that the land of the country should be rationalized and that the State cede the usufruct of the land to landworkers' co-operative societies. This will mitigate the evil of bureaucratic control and management of land which is responsible for the failure of agrarian communism in Russia. A co-operative organization as the Co-operative and the Collectivist Society in Italy which encourages peasant farming by giving expert direction of cultivation, buying and selling has a greater future, because it solves the problem of an inequitable distribution of land resources without minimizing individual initiative.

Social Risks.

As long as there is no radical change in the rural economy of India through land adjustment, agricultural co-operation or scientific farming, the problem of the landless peasants will become more and more acute and there will be a tendency for this class to come in line with the industrial proletariat of the cities. That will portend social upheavals which will be full of grave consequences to the agricultural civilazation of India. In Europe at present there are few countries in which there is no State

machinery for providing landless peasants with land. In peasant countries where the services of the hired labourer are normally only wanted for special seasonal work, there is an almost universal tendency for this class to have a small holding on which they can fall back. In countries where large numbers of such labourers are also employed by capitalist agriculturists there are similar proposals so that the workers' total resources from land and labour shou'd be such as to make it unnecessary for the whole family to take part in field work and migrate from home for a season for that prupose, so far as possible, such seasonal work should be undertaken by adult males preferable at an unmarried age. The land hunger is far more acute in India than in the West and this passion is at the root of most of her rural discontents. Remedial measures will be mere palliative and nothing will check the tide of agrarian unrest than a forward land policy and a series of measures which will protect the small holder from being weakened in his economic position by all those circumstances that have been associated both in India and in Europe in the 19th century with a change from peasant proprietory to peasant proletariat.—*The Modern Review* for October 1924.

X

Notes on the Cultivation and Manuring of Coconuts.

TRENT VALE.

No other crop in the world responds more gratefully to manuring than the coconut.

The difference between an estate which has been systematically cultivated and judiciously manured and one on which the palms have been left to their own devices, without any assistance in the way of tillage and the addition of plant-food, is apparent at the first glance.

On an uncultivated and unmanured estate the palms are invariably stunted and poorly developed, the foliage scanty and yellow in colour and the few nuts scattered here and there amongst the trees give promise of little by way of paying harvest. On the other hand, estate on which the soil has been ærated by frequent cultivations and enriched by periodical applications of manure present a vasty different appearance. The palms themselves are lusty and vigorous, the crowns a wide-spread mass of glossy deep-green foliage and every flowering stalk is thickly covered with nuts.

There are also several other very important differences between a cultivated and an uncultivated estate which are not so immediately apparent to the eye. In the first place, a cultivated and manured estate withstands the adverse effects of a period of drought far better than one

which has been neglected. In the cultivated estate the roots are much deeper in the soil, they have a much greater range in which to search for moisture and palnt-food and the soil itself invariably contains more moisture than an uncultivated estate.

Secondly, the fall of young immature nuts is much less upon a cultivated and manured estate. The fall of young nuts is the source of very serious loss to the coconut planter and anything which can be done to prevent it is worthy of his closest attention. The premature fall of nuts is brought about by the weakness of slender stalk which connects the butt to the flowering spike. On neglected estates these stalks are feeble and brittle the consequence being that many of them snap when the palm is shaken by the wind or when the growing nut is pushed aside by a more robust neighbour. On those estates which are cultivated and manured these stalks are much more strongly developed and they are also far more supple with the result that they merely bend instead of breaking when they are subjected to extra strain.

Thirdly, the meat of nuts grown upon cultivated and manured estates is much thicker and heavier than that of nuts grown upon neglected estates, the farmer therefore require fewer nuts to produce a candy of copra and they command a higher price when sold direct to the desiccating and oil mills.

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The proper time to commence to manure coconuts is when the young seedlings are transplanted from the nursery to the field.

This is a critical period in the life of the young palm when it is naturally in a weakened condition, this disability being brought about by two distinct causes.

In the first place the food in the form of the meat in the nut is at this time on the point of being exhausted. When the embryo commenced to germinate it was supplied with a lavish store of food upon which it could draw freely and this enabled it to put forth a number of roots and a few green leaves. But the time soon comes when the growing plant has consumed the whole of the meat contained in the seed-nut and thenceforth it has to fend for itself. It is now weaned, and from this time onwards the only food it can obtain is that which it is able to extract from the soil and from the atmosphere.

This change over in the source of the food supply is a critical period in the life of all young things, both animal and vegetable, and at no other time in the whole course of their existence do they benefit so greatly by a supply of foodstuffs suitably chosen to meet their special requirements and to enable them to weather this transition period successfully without being unduly checked in their development.

Secondly, it is just about this time that the young palms are removed from the nursery to their permanent situations in the field. The transplanting of young seedlings is of course an essential practice in successful estate mangement cheifly because it enables the planter to select his future palms; he takes advantage of this opportunity to stock his fields with robust young plants and to reject those which shew signs of feebleness and of unsatisfactory growth. Nevertheless, the removal of the seedling from one spot to another, however carefully it may be done, inevitably causes a temporary check in the growth of the plant. The tender roots have to be cut back, otherwise they die back from the ends, and thus the plant is temporarily deprived of the greater number of the feeding portions of its roots.

For these principal reasons everything possible must be done to succour the young palms during this particular period and, if the following rules are carefully observed, it will be found that the seedlings will rapidly recover from the set-back brought about by the change in the source of food supply and by the removal from the nursery to the field.

The holes which are intended to receive the young palms should be dug two or three months before the time of transplanting, and they should be in the form of cube with sides of three feet.

These holes should be left open until a week before transplanting takes place when they should be filled to a depth of two feet with surface soil collected from around the holes. With this surface soil should be mixed a small quantity of soluble and readily available plant-food which will nourish the tender seedling at the precise moment at which it specially requires such assistance.

It is a common practice in Ceylon to place quantities of cattle manure and ashes in these holes but in doing so the vitally important point is entirely overlooked that neither of these fertilizers is of any use to the plant for some considerable time after it has been placed in the soil.

A number of complicated chemical changes have to take place before the food in these manures is rendered available and until these changes have been effected the plant can make no use whetever of them. Both cattle manure and ashes are excellent forms of fertilizing material when used at the proper time and in the proper way, but so far as the young seedling is concerned at the time of transplanting they might just as well not be placed in the holes at all for all the good they do.

The case is vasty different when small quantities of concentrated and immediatly available plant-food is mixed with the soil in the holes.

Such fertilizers have only to enter into solution in the soil moisture and the plant can at once commence to feed upon them. By the time the actual transplanting takes place, therefore, the soil in the holes will be impregnated with available plant-food which will be taken up by the roots immediately the absorbing tips come into contact with it.

For this purpose no better mixture could be devised than the following :—

		Nitrogen	Phosphoric Acid	Potash
150 lbs.	Superphosphate	..	27 lbs.	..
150 lbs.	Nitrate of Soda	23 lbs.	..	..
50 lbs.	Muriate of Potash	..	..	26 lbs.
350 lbs.		23 lbs.	27 lbs.	26 lbs.

Application.—2 lbs. of the above mixture to be incorporated with the surface soil placed in each hole.

This mixture is of a fairly concentrated nature, containing between six and seven per cent of each of the fertilizing materials—nitrogen, phosphoric acid and potash, and all the plant-food is in an immediately available form so that there is no question of any delay being incurred before the seedling can make use of it.

By applying two pounds of this mixture to each young plant a total of a little over one hundred-weight per acre is required the cost of which is trivial compared to the immense assistance it affords the seedlings at just that one time above all others when such assistance is most beneficial and most necessary. About one week after the holes have been filled to a depth of two feet with surface soil impregnated with artificial plant-food the seedlings should be transferred from the nursery. Naturally only the sturdiest of the youngsters should be selected for transplanting and these should have their roots trimmed back a few inches with a sharp knife. They should then be planted out in the specially prepared holes so that the top of the seed-nut is just about six inches below the ordinary level of the soil. No advantage whatever is gained by planting the seedlings any deeper in the soil than this, in fact the development of the young plant is greatly retarded by over-deep planting.

The seed-nut itself should be completely covered with soil and the earth should be carefully pressed firmly round the nut by the hand.

The holes will now be about five inches deep with the well-developed leaves of robust young palm growing from the centre of each hole.

While the growing palms require a constant and adequate supply of moisture it is a great mistake to allow stagnant water to lie in the holes. To prevent this, where the slope of the land permits, small

gullies should be cut to carry away any excess of water, while in flat fields where such gullies are impracticable the holes must be filled up to the normal level of the soil so as to prevent water from remaining round the plants.

The next thing to do is to protect the palms from grazing animals and this is probably best effected by erecting stout walls of husks four or five feet away from the plants well outside the spread of the leaves.

The soil inside these walls should receive constant tillage by forking to a depth of at least 6 inches. The importance of this cannot well be exaggerated. Such tillage not only ærates the soil and conserves the moisture but it also ensures that the roots will develop deeply in the soil right from the very commencement. The roots of the palm, like the roots of all other cultivated plants, must breathe. If cultivation is neglected the soil becomes compact with the result that air is excluded from all but the top inch or so of soil the consequence being that the roots are forced uqwards and are confined to the surface layers only, this being the only place in which they can breathe. The evil effects of this state of affairs are manifold. During periods of drought the roots suffer severely from the scorching sun, they are parched by the lack of moisture—the top two inches of soil being invariably the driest, except of course immediately after rain—and they can search for plant-food only in a very restricted portion of the soil.

Moreover, when once this condition has been allowed to develop it is an exceedingly difficult business to rectify it. The roots will be confined in the form of a thick mat in the top three inches of the soil and to plough or dig the whole state in this condition would be to cut every single root into a hundred pieces. If such a process did not actually kill the palms it would at least inflict upon them such a severe check that it would take them several years to recover from it.

However, if these roots have been kept down to the proper depth by adequate forking and, later, by ploughing, this difficulty will never arise and the palms will develop quickly and strongly.

When the above programme is carried out carefully and thoroughly the planter has the satisfaction of knowing that everything possible has been done to give his young charges a good start in life, and he can look forward to the future development of the palms with confidence and assurance.

We have now to consider the treatment of the estate during the time which must elapse before the palms come into bearing.

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"All coconut growers are strongly advised to pay careful attention to the cultivation of their young palms. If this were done plantations in Ceylon would not take an average of ten years or more to come into full bearing."

The above paragraph is extracted from an article written by the Director of Agriculture, published in the November issue of the *Tropical Agriculturist*, dealing with the excellent results obtained from the early manuring of coconuts on the properties of two well-known coconut planters.

This article together with the illustrations which accompany it, should receive the close attention of all interested in coconut cultivation. It will amply repay study.

During the twelve months following the transplanting of the seedlings from the nursery to the field the soil should be cultivated at frequent intervals and kept free from weeds.

The cultivation of the soil is absolutely essential for the production of the maximum development of the young palms. By the repeated stirring of the soil to a depth of four to six inches the moisture is conserved and prevented from evaporation, rain water soaks downwards into the soil instead of running off the surface into the drains, air is drawn downwards into the soil in the wake of the descending rain, and the roots of the palms are kept out of the hot dry surface layers and made to develop deep in the soil where a far greater supply of moisture and plant-food are at their disposal.

The actual amount of cultivation which is carried out during this year will of course be governed by the size of the new clearing, the amount of labour and the number of cattle available for the work. To obtain the best results the land should be ploughed at least three times during the year and harrowed three times also. This would mean that the soil of the new clearing would be turned over and stirred six times during the year and the beneficial effects of such cultivation upon the palms would more than repay the expense incurred.

As a matter of fact the expense involved is very small on those estates which are possessed of a resident labour force and a number of trained cattle, while the increase in the development and vigour of the palms following upon such treatment has only to be seen to be immediately appreciated.

A further effect of such cultivation will be the destruction of weeds. Weeds and grass are a pest upon all coconut estates—with the exception of grass grown upon steep slopes to prevent soil erosion; they increase enormously the loss of soil moisture, they rob the land of valuable plant-

food and they prevent the penetration of air into the soil. But they are particularly harmful in the case of new plantations. The young growing palm requires everything it can get in the way of moisture, plant-food and air and to allow utterly useless weeds to have a share in these good things must obviously result in retarding the development of the palm.

One year after the transplanting of the seedlings they should receive another small dressing of fertilizers to assist them in their growth.

This dressing should take the form of the following mixture :—

	Nitrogen	Phosphoric Acid	Potash
200 lbs. Fish Guano	15 lbs.	17 lbs.	..
150 lbs. Nitrate of Soda	23 lbs.	..	..
150 lbs. Superphosphate	..	27 lbs.	..
100 lbs. Muriate of Potash	..	..	52 lbs.
600 lbs.	38 lbs.	44 lbs.	52 lbs.

Application :—4 lbs. per palm.

This mixture is of the same nature as that used at the time of transplanting except that it contains a good proportion of organic fertilizing material in the form of fish guano.

Fish guano shares with the true guanos the property of continuing to yield nitrogen to the plant throughout the whole growing season, a property which makes it a particularly useful form of fertilizer. In addition to this it contains a valuable proportion of phosphoric acid.

Both these plant-foods, nitrogen and phosphoric acid, are supplemented by the other manures which provide the plant with nourishment more quickly than organic fertilizers. The nitrate of soda provides an immediately available supply of nitrogen and the superphosphate an equally available supply of phosphoric acid. The palm's requirements as regards potash are met by means of muriate of potash which is included in the mixture.

This mixture of manures should be applied to the palms in semi-circular trenches dug not less than three feet away from the base of the trees.

Precisely the same treatment should be given to the palms during the following four or five years as was given during the first year. The soil should be stirred as frequently as possible, more especially during the dry weather, and the same manure mixture should be applied in quantities increasing by one pound per palm per annum up to a maximum of eight pounds per tree.

The only important difference to be observed in the treatment of the estate lies in the method of applying the manure to the palms.

It is frequently insufficiently realized that plant-food applied in the form of manure can be made to serve a very useful purpose altogether apart from the actual nourishment which it supplies to the plant, this purpose being to strengthen and to encourage root development.

The roots of the coconut palm spread out radially from the base of the tree and sub-divide into smaller and more numerous branches as they grow outwards. Plant-food is absorbed by only a small portion of each tiny rootlet, the absorbing area being situated at the tips of the branches immediately behind the root-caps.

Therefore the further away from the palm the manure is applied—provided that the limit of actual root extent is not exceeded—the more feeding tips will it come into contact with and the more readily will it be absorbed by the palm. And the root development which invariably follows an application of manure will be vastly greater when the application is made at a good distance from the palm than when it is made near the base. Not only are there greater numbers of roots to branch and to sub-divide but also the area of soil in which they can develop is proportionately greater. The result of this is that when all the manure has been absorbed the palm is possessed of a greatly increased and strengthened root system through which it is brought into contact with a far larger number of soil particles and thus is able to extract very much more plant-food from the soil.

When properly applied the effect of manure is permanent. While the manure is being absorbed the root system is rapidly increasing by the sub-division of the branches and when it has been completely consumed the newly developed rootlets continue to supply the palm with increased supply of food extracted from the fresh areas of soil into which they have penetrated.

One occasionally hears it said that if you commence to manure coconuts you have to continue to do so; otherwise the palms "go back".

Where palms do go back in this way it will invariably be found that the manures have been incorrectly applied in such a way that little or no permanent root development has been encouraged. This frequently happens when cattle are tied to the palms for the purpose of supplying them with manure. The manure falls within a few feet of the base of the palm and sooner or later a thick mass of fine hair-like roots develop. Now, if only these roots were sufficiently deep in the soil and if only they had sufficient room in which to grow they would be of immense benefit

to the palm. But as a matter of fact they are of very little temporary use to the palm and later on they become actually harmful. They grow right up to the surface of the soil, where they are subsequently scorched by the sun or destroyed by cultivation, and they are so crowded together right in near the base of the palm that they have relatively very little soil from which to extract water and mineral plant-food.

The ultimate result of this is that these newly developed roots die and the palm consequently receives a severe set-back.

Much the same thing is liable to occur when the walls of husks originally built to protect the young palms from injury by cattle are left in one position too long. The roots of the palms are encouraged to grow upwards in search of the plant-food in the rotting base of the wall and, when eventually the wall is cleared away, a circular belt of tender roots is left at the surface of the soil to be scorched and killed. All this can be prevented by applying the manure in the proper way, that is to say, in the proper place and at the proper depth.

Obviously the place in which the roots have at their disposal the greatest area of soil in which to develop and from which to obtain plant-food, is midway between the rows of palms, and everything possible should therefore be done to encourage deep and vigorous root development in this area.

Provided that the young plantation has been cultivated and manured the roots of the palms four years after transplanting will have developed outwards to such an extent that those from one row of palms will meet and intermingle with those of the adjacent rows and from this time onwards the semi-circular trench method of applying the manure should be discontinued and all future applications should be made along a broad strip down the centres of the rows. If artificial manures are being applied all that it is necessary to do is to broadcast the mixture by hand and then plough it under, while if the land is being dressed with cattle manure this should be placed in long trenches three feet wide and six inches deep dug down the centre of the rows.

Now, provided that the young plantation is reasonably fortunately situated in a district where the soil is fairly good and the rainfall adequate as regards both quantity and distribution the palms, if treated in the manner outlined above, will commence to bear nuts in the sixth year after transplanting and the yield will increase rapidly from year to year.

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Very special treatment is required in the case of old estates which have not been previously cultivated or manured,

On these estates it will almost always be found that the soil is very hard and compact and that the roots are matted together in the top two or three inches of soil.

As noted previously, to plough an estate in this condition would mean cutting through practically every single root, a procedure which would have a devastating effect upon the palms. Heroic measures are both useless and dangerous, the work must be taken in hand carefully and gradually.

The first thing to do is to break up the soil and thus allow water and air to penetrate into the lower layers, and this must be done without breaking any large proportion of the roots.

The most effective way of carrying this out is by the use of long tined forks. The forks should be driven right down into the soil, to a depth of eight or ten inches if possible, and pushed backwards and forwards until the crust of earth immediately round the fork is thoroughly broken up. The soil should not be turned over as to do this it would first be necessary to break the roots which is just what should be avoided. After being thrust backwards and forwards a few times the fork should be pulled straight out and driven into the soil in a fresh place.

Alternate rows only should be treated in this way at first and when the field or the estate has been completed then the rows which were missed on the first occasion should be similarly forked.

The effect of this will be that the rain water will sink down into the soil, drawing fresh air after it, and thus new layers of plant-food will be palced at the disposal of the roots, a condition of which they will rapidly take advantage by sending down young rootlets into the areas.

The entire estate should be forked in this manner at least twice during the year, and the same process should be repeated twice again during the second year.

After this it will be quite safe to put the ploughs into the soil, and this should be done as frequently as possible during the third year, the only precaution to be taken being to plough alternate rows first and to allow three or four months to elapse before the second rows are ploughed. If this ploughing is done effectively it will result in the complete destruction of the grass and weeds, a very important point in connection with the welfare of the palms.

During the third year work should be commenced on burying husks. Trenches should be dug three feet wide and three feet deep down the centre of alternate rows, and these should be filled with husks, sprinkled with lime or basic slag, to a depth of two and a half feet, the top six inches being filled in with earth.

Applications of manure should be made annually commencing with the year during which the ploughs are first used, the mixture being the same as is prescribed above.

This special method of cultivation carried out over a period of three years will effectively break up the hardened soil and will result in a very considerable development of the roots of the palm in the deeper layers. Many of the older roots will be broken but not before the palm has been stimulated into producing fresh and vigorous root-growth.

Once a fine tilth has been obtained in the surface layers every care should be taken to preserve it and to prevent the soil from again setting into hard cakes.

Henceforth the old estate should be treated in the same manner as that detailed above for young plantations ; the soil should be ploughed and harrowed as frequently as possible, the light harrows being kept busy every day during the dry weather in order to break up the surface and to prevent as far as possible the evaporation of the soil-moisture, and the estate should be dressed once a year with the mixture of manures at the rate of eight pounds per palm.—*Indian Scientific Agriculturist*, Vol. V, Nos. 4, 5 and 6.

XI

Selection and Care of the Dairy Herd Sire.

The Sire's Place in Herd Improvement.

The cheapest and by far the most satisfactory method of improving the quality of a dairy herd is to raise cows of high producing ability for the herd rather than to buy them.

To those dairymen who hope to improve their herds by replacing old cows with heifers of their own raising, the herd bull is of greatest importance. The character of any herd which is replenished by breeding rather than buying is a reflection of the quality of the bulls that have been used. The quality of the herd bull used at present determines the merit of the herd a few years in the future. The adage "The bull is half the herd" certainly does not place enough importance on the bull from the standpoint of herd improvement. In order for a dairyman to improve his herd through breeding the sire used must be better than the cows composing the herd.

Choosing the Breed.

A bull to head any well-established herd should, of course, be of the same breed as the cows of the herd. It is folly to use a bull of one breed on cows of another in the hope of developing animals bearing the good

points of both. The undesirable points are just as likely to combine as are the good ones. Further, the chain of inheritance which has been established by long continued breeding for certain characteristics has been broken in the resulting calves of such a cross so that it is not possible to predict what characteristics they may transmit to their offspring.

Where a dairy herd is in the process of establishment and scrub cows or cows of mixed breeding are on hand, the bull selected should be a representative of the breed whose characteristics adapt it best to conditions under which it must work. In a case of this kind the breed should be chosen after consideration has been given to a number of factors, chief of which are :—

First, the dairy breed most popular in the community. The more popular a breed is the more readily will young stock of that particular breed sell, so that as a rule it is good business to select the breed of dairy cattle that is already well established in the community.

Second, the adaptability of the breed to natural conditions. If no dairy breed has a firm hold as yet, the characteristics of the different breeds should be carefully studied and that breed chosen whose characteristics adapt it best to the care that can be given, the crops grown, and grazing conditions.

Third, the market for the dairy products is a factor in determining the breed which will do best. If whole milk is sold by weight, regardless of test, there is no doubt but that the Holstein has the advantage over the other dairy breeds. Under other conditions, however, the Holstein may take a lower rating.

The Sire should be Pure Bred.

In the light of present common knowledge it is of course needless to say that the bull at the head of any dairy herd, be it scrub, grade or pure bred, should himself be a pure bred. The long continued breeding of dairy cattle has resulted in the establishment of certain characteristics which are very much more sure of transmission through a pure bred than through a grade.

There is plenty of chance that the daughters of a pure bred bull will be disappointing. There is infinitely more chance that the daughters of a grade or scrub bull will prove to be inferior so that the dairyman cannot afford to waste his time with a grade or scrub bull. There are plenty of pure bred bulls available in this country.

The Advantages and Disadvantages of Young and Old Bulls.

Most men prefer to buy a young bull rather than an old one. However, both young and old have their advantages and disadvantages.

Some of the advantages of buying a young bull are as follows :—

1. A young bull is easy to handle and can be trained according to the method used by the purchaser. Most bulls that are vicious become so due to improper handling when young. A bad disposition can usually be avoided if the bull is bought as a calf and properly treated.

2. The cost of shipping is small. If an animal has to be shipped a long distance by express, the difference in charges on a small animal and one that is mature amounts to a considerable sum.

3. A young bull can usually be bought cheaper than one ready for service or mature.

4. There is less chance of buying disease with a young bull than there is with a bull that has been in service. From present knowledge it seems that contagious abortion will seldom be carried by a bull calf. Any animal above the age of six months should, of course, be tested for tuberculosis so that the danger from this source can be entirely avoided, no difference what the age of the bull may be.

5. A young bull can be fed so as to develop up to the limit of his ability. Proper feeding undoubtedly has a large effect on the growth and development of the calf.

6. If a bull is bought young and proves to be the right sort of a sire, he has a long period of usefulness before him.

Some of the disadvantages of buying a young bull are :—

1. A young bull is untried and the buyer must wait about three years after he is old enough for services before his merit as a sire can be known. If he proves to be an inferior sire and has been in use in a herd during that time, he will have almost ruined it. The risk which a man takes in buying a young bull and putting him into exclusive use should not be overloooked.

2. If a bull calf is bought, one cannot be sure how he will develop. Some very nice looking calves develop into ungainly animals. A good looking bull on the place is, of course, an asset in that it helps in the sale of young stock.

Some of the advantages of buying an old bull are :—

1. It is possible to get a tried bull. If a person selects a bull that has a large number of daughters in milk and these daughters have shown a decided improvement over their dams, there can be no doubt but that the bull is a good individual and a dairyman is taking little risk in buying an animal of this kind. He can be put at the head of a herd without fear of bad results.

2. When an old bull is purchased his conformation is known. There is no chance for it to change, as in the case of a calf,

3. When an old bull is bought his disposition is usually determined. An old bull that is gentle does not often develop into a vicious animal later on.

Some of the disadvantages of buying an old bull are :—

1. An old bull may often be vicious and hard to handle, which necessitates the building of a special pen or stall if the safety of the owner is to be guaranteed.

2. There is more chance of buying disease with a mature bull that has been in service for a number of years than in buying a young bull that has not been used.

3. If an old bull is to be shipped, the charges will amount to considerably more than those on a young bull.

4. An old bull may not last long. One cannot tell how soon a bull will lose his vitality and become useless as a breeder, though with proper treatment throughout life, a bull should last until he is ten or twelve years old.

5. A mature bull of the merit wanted is often hard to buy. There are relatively few in the country and those that are known are usually priced at figures that seem too high to the ordinary dairyman.

Although all of the factors mentioned may have some influence with the purchaser of a bull, still the fact remains that what is most wanted in a herd sire is the ability to improve the productivity of the herd and this ability can be detected with certainty in the tried bull. On the other hand, a person can never be absolutely sure of this ability in a young bull until he has been tried, even though his pedigree be good. The advantages are certainly in favour of the mature bull if he can be purchased at anything like a reasonable price.

Selecting the Bull.

In selecting a young bull the ancestry and individuality are the things on which the purchaser should base his opinion. Of these, the ancestry is the most important.

If possible, the bull selected should come from a dam having a high official year's record, or better still, for a series of years. It is, of course, to be desired that all dams close up in the pedigree have large yearly records.

Next in importance to the dam's merit should stand the merit of the half sisters on the sire's side. These half sisters should be uniformly good. A few half sisters with extremely high records and others of inferior quality should not be a recommendation to a bull.

A yearly record is, of course, to be preferred to a short time record,

A seven or thirty day record, while valuable, tells little of a cow's persistency and the test reported is very often abnormal because it is so easily raised by having the cow fat at the beginning of her short time test. For this reason the quantity of milk produced is by far the better guide to merit in the case of these short-time records than the amount of fat produced.

It is, of course, desirable to see the animals themselves as far back in the pedigree as possible. These animals should show large size for the breed because size has been found to be some index to productivity. The cows should also show large udders, attached far forward and far up behind and hung close up to the body. The markings of these animals, while not indicative of milk yield, do have some bearing on the ease with which young stock may be disposed of and for that reason, be carefully considered.

The individuality of the young bull is of relatively small importance as compared to the ancestry. Many prize winning bull calves have proven very inferior as breeders and on the other hand many bull calves that are really inferior in conformation have proven highly valuable as herd sires.

The old bull should always be selected according to his performance. If a bull can be found whose daughters have all been good producers, regardless of the kind of dams with which he was mated, it is proof that he is able to transmit high producing qualities. A dairyman can put such a bull at the head of his herd with entire confidence that the resulting daughters upon coming into milk will prove worthy of a place in the herd.

A mature bull should not be selected from the records of a small number of the daughters because even the poorest bull is likely to sire a few good daughters. Neither should a large number of daughters of good quality be regarded as a pure indication of merit unless it be known that these daughters make up a very large percentage of all the daughters sired by this bull. In this respect records kept by the different breed associations may at times be misleading because there is no way of knowing how many of the sire's daughters do not prove out well.

The conformation or form of a tried bull is of little consequence as long as he has the ability to transmit the right kind of characters. However, other things being equal, the good-looking bull should be selected in preference to the one of less attractive appearance because sales of surplus stock can be made more readily when the herd bull is a good-looking one.

The pedigree of the tried bull should not be a weighty influence in

his selection. A good pedigree is of some importance, however, because it will appear as part of the pedigree of each calf sired by this bull. Many a prospective buyer would be willing to make some distinction in the prices of two calves according to whether the pedigrees of the sire were strong or weak, even though the two sires were equally able to transmit the desired characters.

There can be no doubt but that the selection of the proven mature bull is good business, even though the price paid be double or treble that of a young bull.

Precautions in Buying.

In buying a herd bull every precaution should be taken to get a quick, sure, and regular breeder. The vigour and ambition of a bull can readily be determined by the quickness with which he serves a cow. A bull's sureness of breeding is commonly guaranteed by the seller and this guarantee should always be demanded by the purchaser. If the bull is not a breeder, he is, of course, worth nothing more than what he will bring for beef.

Diseases, such as tuberculosis abortion, should be guarded against. Tuberculosis can be avoided by having the animal tested by a qualified veterinarian. This test should be made in case of every purchase, no difference whether it is required by law or not. It should be made as a protection to the purchaser's herd. If it is not made before the bull is brought to the purchaser's farm, he should be isolated from all other animals until the test has been made.

Contagious abortion is likely to be more disastrous to the dairy herd than tuberculosis. If the bull comes from a herd known to harbour this disease, he should at once be disinfected thoroughly by scrubbing him all over with a three per cent solution of carbolic acid or some other good disinfectant. In addition, his sheath should be washed out with one-half per cent carbolic acid or creolin or one-fourth per cent Lugol's solution. This treatment should be repeated before he is allowed to serve a cow.

It is sometimes hard to tell when a dairy herd is infected with contagious abortion, but whenever the calf crop is seen to be too small to be in proportion to the number of females in the herd a person has a reason to be suspicious of the health of the herd. Whitish discharges from the vagina are also usually noticeable in cows suffering from contagious abortion, although this disease is by no means the only cause of such discharges.

A Herd should not be Sold Too Soon.

A bull that has been given good care along with moderate use should retain his vigour up to the age of ten or twelve years. However, there are very few bulls kept on one farm until they are thus old. It usually happens that a bull is used for two years—that is, until his first daughter is old enough to breed—and is then offered for sale. Too often he goes to the butcher before anything is known as to his real value.

To retain a bull in the herd longer than two and a half years, of course, necessitates the keeping of another bull. But even under these conditions it is desirable to keep a bull longer than two and a half years. If he be a proven bull he should be kept for mating with those cows that are not too closely related to him and the young untried bull, if such be used, should be mated only with those cows that are closely related to the proven sire. The cows mated with the untried bull should be limited in number until he has proven his worth.

After a young or untried bull has been used for two years he should not be sold to the butcher because his daughters, when they freshen, may prove him to be of exceptional worth. Such a bull can often be loaned to a man with a grade herd for a couple of years until some of his heifers freshen. In this way he is always subject to recall in case he proves especially valuable.

In fact, some of the best breeders follow the practice of loaning out a number of their young bulls in the community merely for the purpose of trying them out. Of course, many of these bulls prove to be mediocre, but when a valuable one is found he is the property of the lender and well repays any expense involved in his discovery.

Disposing of the Bull.

A sire that has proven his worth is always in demand and can be sold readily if the public knows of his whereabouts. A purchaser can always be found by advertising.

Amount of Service to Expect from a Bull.

A mature bull, well fed, could possibly serve 200 cows a year if the cows were evenly distributed in each week. This would be at the rate of four cows per week. Under herd conditions, however, where the breeding is not evenly distributed throughout the year, a bull should not be allowed to care for a herd of more than 50 to 60 cows.

A bull that has not attained his growth cannot, of course, care for a herd of more than 20 to 30 cows without risk of stunting his development and injuring his breeding power.

A bull should never be allowed to run with the herd because :—

First, there is no way of telling what cows are safely with calf and as a result sterile cows may be kept in the herd when otherwise they could be disposed of. Also cows that are shy breeders may not be discovered in time for proper treatment.

Second, there will be no way of telling when to expect the calves, so that cows may be milked right up to the time of calving. In order to best prepare a cow for her next milking period she should be fattened somewhat. This can be done best when the cow is dried up for a period of about six weeks.

Third, if heifers run in the same pasture they will be bred before they are sufficiently developed, which results in small or stunted cows. Such cows remain inferior throughout their lives.

Fourth, in the case of certain pure breeds, calves cannot be registered if they are the result of pasture services. Some breed associations require the exact date of breeding to be kept.

Fifth, when allowed to run in the pasture a bull will waste his vitality because he will serve a cow a number of times. One service is efficient unless it be in the case of a heifer bred for the first time. It is possibly better in such cases to allow two services. A bull is always to be regarded as dangerous, even though he may appear to be perfectly gentle. He should always be handled with a staff in preference to a rope or chain, as the attendant can keep him at a distance with the staff.

Breeding Records.

A record of breeding is almost invaluable to the dairyman.

Cow	Date Bred	Bull	Date Due	Date Calved	Sex	Mark	Remarks
Rose	Sept. 21	King	June 30	June 26	H	16	..
Beauty	Oct. 1	King	July 10	July 11	B	..	Vealed

This illustrates a simple, yet satisfactory, method of keeping a breeding record.

1. It tells him when to accept a calf.
2. It is required by certain breed associations before a calf can be registered.
3. It is of value in determining the age and parentage of calves.

For convenience a gestation table should be pasted in the back of the book used as a breeding record.

Feeding the Dairy Bull.

There can be no doubt but that the majority of dairy bulls receive too little feed for best results. The belief is widespread among dairymen

that a bull is likely to be rendered less sure as a breeder by liberal feeding. This is no doubt true in cases of extremely heavy feeding, but the usefulness of bulls is in reality more often limited by too scanty feeding than by too liberal feeding.

The hay fed to bulls in Washington is usually alfalfa, clover, oat, or a mixture of clover and timothy.

These are all good. If the bull is fed straw as his roughage it is essential that more grain be used because of the lower amount of protein contained in the straw than in the hays mentioned.

There is a widespread opinion among dairymen that the feeding of silage is likely to injure a bull's breeding power. There is no doubt something to this. In the opinion of the writer the injury may be due to two things :—

1. The bull may be required to consume too much bulk in order to get the proper amount of nourishment. This bulk enlarges the bull's abdomen and makes him clumsy and sluggish.

2. The feeding of large amounts of corn or oat silage, especially with a hay rather low in protein, is likely to provide a ration containing entirely too much carbonaceous material in proportion to the protein. The bull receiving such a ration might remain in fairly good flesh and still not be getting enough protein to keep him in a vigorous condition.

If the injurious effect of silage is brought about in either of these two ways, it can be overcome by feeding silage in limited amounts and supplying considerable protein in the grain.

This has been done with good results. At one time bulls under the care of the writer were fed about twenty pounds of corn silage a day during the winter season. As the weather became warmer, the amount of silage fed was decreased to about fifteen pounds. The bulls were housed in a shed open to the south during the entire winter. If they had been kept in warm stalls, the amount of silage fed possibly would have proved too much for best results.

A bull allowed to run in the open or kept in an open shed naturally requires feed of a more heating nature than a bull given protection. This accounts for the fact that it is possible to feed more silage to bulls running in the open than those kept closely housed.

The mistake is often made of feeding bulls too little grain. It is a common practice to expect the herd bull to make his living entirely from roughage. There is also a danger of feeding a bull too much heat-producing feed, such as corn. A bull may be so fed that he will stay in good flesh and still not be vigorous. This condition may be brought about by the feeding of a ration containing too little protein. In such

a case the flesh which the bull carries is not a safe state of flesh but in addition he should be vigorous and have plenty of ambition.

A very good practice is to feed the bull a ration containing a considerable amount of protein. The very same mixture that is used for the cows may well be fed to the bull. The following mixtures will give good results :—

Corn or Barley	100 lbs.	Bran	200 lbs.
Bran	300 lbs.	Oats	200 lbs.
Linseed oilmeal	50 lbs.	Linseed oilmeal	50 lbs.
Total ..	450 lbs.	Total ..	450 lbs

These mixtures should be fed in amounts sufficient to keep the bull in fairly good flesh, three to five pounds daily being fed during the winter. There is very little danger of getting a bull too fat, providing he is fed a ration of this nature.

Housing the Bull.

It is much better to let the bull rough the weather than to house him too well. Many men make the mistake of thinking that the herd bull cannot withstand the cold. As a matter of fact, he will do better when given a stall that is dry and only sufficiently tight to break the wind than when he is housed in a close, warm stable. Fresh air is essential to good health in any animal.

It is a good practice to house the bulls in a shed entirely open to the south. This keeps the pens dry at all times and provides plenty of fresh air but the temperature of the shed is very nearly the same as that on the outside, so that the bulls are really exposed to a dry cold.

Exercising the Bull.

Exercise is essential to good health. If a bull is kept in a box stall for months at a time without being allowed to exercise, he will in time likely become impotent.

Some bulls naturally exercise more than others. If a bull is of a rather nervous disposition, all that is necessary to give him exercise is to allow him the run of a lot of considerable size. Others are so sluggish by nature that they will not take sufficient exercise even when allowed plenty of room.

There are several ways of giving bulls exercise. One of the best ways, where several bulls are kept on one farm, is to provide a lot of considerable size and turn the bulls together. Several bulls in the same lot will exercise much more than one bull by himself. There is little danger of the bulls hurting each other after they have become accustomed to being in the same lot. When one becomes master, the others keep out of his way and there is no fighting.

Another method sometimes used is to put the bull on a tread mill. This system, however, is often unsatisfactory because a bull will sometimes refuse to walk on the incline unless he is watched. Further than that, the incline may become wet and slippery and give chance of injury to the bull. If a tread mill is used, care should be taken not to overexercise the animal. From half an hour to an hour's exercise each day after the bull has become accustomed to it, is suggested.

Some breeders follow the practice of putting a long pole on a pivot in the lot and tying the bull to the end of this pole, making the tie rather short. He can then walk around in a circle, going in either direction.

Some men have used a pole set at an angle with a stump or rock hung about four feet above the ground on a rope or cable from its end. The bull takes great delight in fighting this stump or rock and gets considerable exercise. Some breeders, however, think that this form of exercise makes the bull more unruly and vicious than he would otherwise be.

A system in use in certain dairy sections is to tie the bull to a weight and allow him to graze around it. There are some advantages to this that the bull can be moved to a new spot each day and in that way can get considerable grass. The best way to tie a bull, if this system is used, is to put a chain around his horns and pass this down the front of his face, through his ring. A rope is then attached to this chain and tied to the weight. If this system is used no bull lot is necessary as the bull can be taken to any spot around the barn or lots that may be available.

Where the time can be spared, leading is the best exercise of all. This accustoms the bull to handling and the amount of exercise can be regulated to a nicety.

Developing the Young Bull.

The bull calf should be well fed in order to develop the greatest growth and bring him into serviceable condition at the earliest age. It is well to continue the feeding of skim milk until he is eight or ten months of age. Skim milk fed to a young bull is used to good advantage.

The young bull is usually ready for service at the age of ten or twelve months, but he should be used sparingly at this time. As a rule he should be allowed to serve not more than two or four cows before he is a year of age and from that time his use can gradually be increased until he is two years of age, when he should be able to serve three cows a week and even more during the breeding season.

Rules for Managing the Bull.

If a herd bull is to be kept in good breeding condition for a number of years, the following rules should be observed ;—

1. Give the bull plenty of exercise and allow him to have plenty of fresh air.

2. Feed the bull liberally, being sure that he secures sufficient protein in his ration.

3. Use the bull intelligently. Do not allow him to make more than four or five services in one week. Bulletin of the Union. Dept. of Agriculture.

Agriculture—The Birthplace of Credit.

The cultivation of the ground including the harvesting of crops and the rearing and management of live-stock, is not only the oldest, but the most widely dispersed occupation of civilized man. The interval between seed time and harvest, between the rearing and killing of beasts, probably necessitated in the earliest times the use of some system of credit. Indeed, it may be assumed that agriculture gave birth to the conception of credit. It is, therefore, natural that credit should have come to be regarded by the farmer as an essential element in the productive process. Although there has been a tendency in most countries to isolate "agricultural credit" and to treat it as a peculiar credit problem demanding special consideration, fundamentally credit plays the same part in agriculture as in any other industry.—Report of the Committee appointed by the Government of Great Britain to inquire into the question of Agricultural Credit.—*Agricultural Gazette of New South Wales*, Vol. XXXIV, No. 6.

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DEPARTMENT OF AGRICULTURE, MYSORE STATE.

CIRCULAR.

Coffee Borer.

As a result of the materials used for washing coffee stems proving unreliable from their variation in chemical composition, it was decided last year to try other methods to control the coffee borer. Two were tested ; on an estate near Saklespur, one of hand picking the adult beetles during the period of flight and the other of wrapping the stems with strips of date palm matting, old newspaper and 'Thermogem'. The results show that hand picking is the cheaper and easier method and the more effective. The picking was carried out by five boys over 5 acres during November and December 1923 at a total cost of Rs. 50. The results were ascertained in July last when the badly infested trees were as usual pulled out. It was found that in the 5 acres only 540 trees had to be removed against 1,139 in the adjoining check plot. This is encouraging considering that the picking could only be started about 10 days after the flight commenced. The boys found no difficulty in identifying the beetle and very easily distinguished them from other species similar but distant which were shown to them. The payment was according to the number caught but the rate was varied so as not to exceed very much beyond the daily wages without at the same time weakening the stimulus that is necessary for careful search. Only the labour was supplied by the manager, the wages were paid by the Department. The manager of the estate is, however, so well pleased with the results that he has offered to do the work in two of his estates during the next season at his own expense the Department supplying only the trained supervision.

It would be very helpful if the estate managers in other localities such as Balehonnur and Santveri within the State with different elevation and rainfall will also undertake systematic hand picking on their estates on the same conditions. It is not known yet whether under all conditions the beetles could be as easily caught. Experience is required for which work on similar lines in representative localities is necessary. Those who cannot find labour to cover the entire estate may confine hand picking to the worst infested blocks. The Department is prepared to furnish trained supervision for work on a limited number of estates in the State. To others outside the State beetles with similar species with which they are likely to be confused will be sent pinned and labelled and also all instructions necessary to enable the work to be carried out satisfactorily. Estate managers who desire to give the method a trial are requested to communicate with the undersigned.

K. Kunhi Kannan, M.A., Ph.D., F.E.S.,
Entomologist to the Government of Mysore, Bangalore.

Exchange List, 1924.

1. The Journal of the Ministry of Agriculture, England.
2. The Agricultural Journal of India.
3. The Tropical Agriculturist, Ceylon.
4. The Planters' Chronicle, Coimbatore.
5. The Journal of the Madras Agricultural Students' Union, Coimbatore.
6. Indian Scientific Agriculturist, Calcutta.
7. The Tropical Life, London.
8. The Implement and Machinery Review, London.
9. The Modern Review, Calcutta.
10. The Mysore Economic Journal, Bangalore.
11. The Mysore Engineers' Association Bulletin, Bangalore.
12. The Planter, Kuala Lumpur, Federated Malay States.
13. The Malayan Agricultural Journal, Federated Malay States.
14. The Agricultural Gazette of New South Wales, Australia.
15. The Review of Applied Entomology, London. (Agricultural Series.)
16. Bulletins of the Deli Experiment Station, Sumatra.
17. The Journal of the Department of Agriculture, Porto Rico.
18. The International Review of the Science and Practice of Agriculture, Rome.
19. Reports of the Agricultural Department, Colony and Protectorate of Kenya, British East Africa.
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